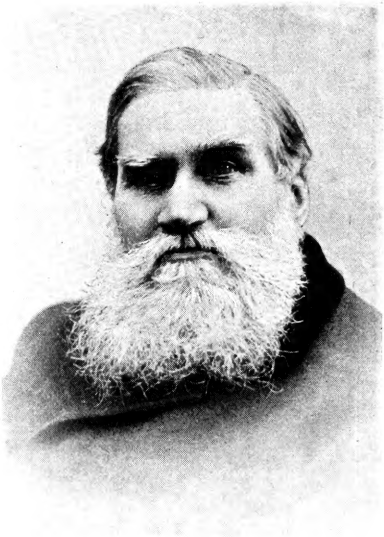
TRANSACTIONS

OF THE

EDINBURGH FIELD NATURALISTS'

AND

MICROSCOPICAL SOCIETY



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TRANSACTIONS

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EDINBURGH FIELD NATURALISTS'

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INSTITUTED AS THE

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VOL. III.

(*SESSIONS 1891-98*)

Published for the Society by

WILLIAM BLACKWOOD AND SONS

MDCCCXCVIII

CONTENTS.

SESSION 1891–92.

SESSION 1892–93.

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VOL. III. PARTS I.-III.

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ANDREW MOFFAT,

SECRETARY, EDIN. FIELD NAT. AND MICRO. SOC.,

1873–1894.

CONTENTS.

SESSION 1893-94.

TRANSACTIONS.

SESSION 1891-92.

I.—*DRAGON-FLIES: THEIR LIFE-HISTORY.*

BY MR WILLIAM COATS.

(*Read Nov. 25, 1891.*)

THE leafy month of June, that loveliest segment of the year, bestowed by Nature on those whose eyes and ears have been opened to the beautiful in sight and sound, brings us, among other recurring beauties, the dragon-flies. The light and graceful forms of these insects, their beautiful and varied colours, their large and lustrous wings, their eager and rapid flight, render them objects certain to arrest and rivet our attention wherever met with. Splendid but voracious, rivalling with their brilliant metallic hues our butterflies in their varied and gorgeous colourings, they are then entering upon their last and mature stage of existence, which, for however long it may extend, is principally devoted to the continuance of the species. Having quitted an aquatic, or more properly a mud-grovelling existence, the remainder of their life is passed revelling in the luxury of sunshine—a fitting termination to a life-history so wonderful.

At one time it was thought that insects, during their existence, passed through four distinct stages—viz., the egg, the larva, the pupa, and the imago or perfect insect—but it is now known that the metamorphoses which those belonging to the different orders undergo vary in degree and differ widely one from another. Like all those with *incomplete* metamorphoses (*i.e.*, in which the changes are not sharply defined), dragon-flies have no quiescent pupal condition, no abrupt transition between the larval and the "nymph" or pupa stage; what changes there are consist principally in increase in size. The eggs are deposited in water, and when hatched give rise to the larvæ. These and their further advanced form or pupæ are entirely aquatic, living at the bottoms of ponds, chiefly in the mud or on the submerged parts of water-plants.

The larval or first stage of life, properly so called, is one of sterility, in which existence is usually more prolonged than in any other. In it the active larva—one of the most predaceous of insects—does nothing, from the moment it emerges from the egg to the time when it quits the water to be transformed into, or rather emerge as, the perfect form, but eat voraciously to satisfy its insatiable hunger,—the result being rapid increase of growth. This enlargement renders the casting of the skin, or moulting by means of a split in the back, a necessary process. The number of moults is uncertain, but doubtless they are numerous; and on dissecting the larva, one is almost sure to find the skin for the succeeding period of growth. At probably about the penultimate of these operations rudimentary wings begin to appear as thoracic offshoots, in the full-grown nymph form extending about half-way along the back; and as ability to eat continues as before, they form the only real difference between the two stages, or rather an indication of the latter of the two. The following instance, in illustration of the nature of the insect in this stage, was brought under my notice during this last summer. A gentleman, walking along the canal bank one evening, observed a perch of medium size swimming rapidly in circles, diving suddenly, and performing strange evolutions. He hooked it out with the handle of his walking-stick, and found a larva of dragon-fly holding on to the under side of the perch, and the fish had been struggling to get rid of its tormentor. I tested their devouring capabilities by placing three of these large larvæ in a vessel along with a quantity of frog-spawn and a few larval forms of other insects. The latter they quickly demolished, and the spawn, when hatched into tadpoles, disappeared steadily night after night, the remainder, numbering about fifteen, being cleared out in a single night, and this when they were between half an inch and three-quarters of an inch in length.

The duration of the aquatic life is no doubt variable according to the species. In the smaller forms it is probably less than a year, but definite evidence is wanting as to the occurrence of two broods in one year. On the other hand, as I have taken larvæ in full vigour from the bottom of a pool at the end of September, it is certain that often a longer period is requisite to enable the creature to attain its full growth, and three years have been stated to be necessary for this in the large and powerful Anax formosus.

As is seen from the three specimens shown, representing the three tribes into which dragon-flies are now divided, there are two principal types of larva. One is broad, thick-set, and clumsy, producing the larger and stouter dragon-flies; the other slender, and carrying leaf-like appendages at the tail. These latter are the immature condition of the slender and graceful members of the group. In the former we see a very dingy, unprepossessing, and ugly creature, of a dirty-green colour, with six sprawling legs, a broad flattened head, prominent eyes, and two very short antennæ. The thorax has rough ridges on its upper surface; the abdomen, broadest a little behind the middle, has at its extremity some stout spine-like processes surrounding the terminal orifice of the digestive tube. In the second type the body is elongated, and tapers to the extremity of the abdomen. It is also capable of vigorous movement from side to side. The eyes are if anything more prominent, giving the insect a hammer-headed appearance. These larvæ possess a gizzard—absent in the perfect insect—to assist in triturating the hard parts of their food. In the first type it has four protuberances, each furnished with five or six teeth; in the second type—the larva of the Agrionidæ—the gizzard has ten divisions, each of which is furnished with many minute teeth in the centre, and above these a second row with fewer teeth. The $\frac{1}{2}$-inch objective is required to make them out well.

One of the remarkable peculiarities of the larvæ of dragon-flies, testifying not only to their voracity but to their sluggish habits as well, is the curious modification of the labium or lower lip, long ago termed a "mask,"—a term, however, which does not indicate its full character. Of this almost unique organ I have made preparations from three different species. It is seen to conceal the mouth entirely, is sometimes flat, sometimes arched, and serves the function of an arm and hand, furnished in the largest species with two very strong claws or pincers, and within them two movable parts supplied with a row of teeth. Imagine your arm attached to your chin or neck, and you have an idea of this powerful prehensile organ. It has two joints: the first forms the attachment under the head, and, along with the second, thrusts the apparatus outwards with astonishing rapidity for seizing prey, or withdraws it to its resting position. The second joint, when the apparatus is folded up, reaches backward to the second pair of legs, and when thus folded the strong claws are, with the prey they may have seized, brought into close contact with the mouth. In the Agrionidæ the mask is triangular in outward appearance, and the claws show a development approaching the large claws of the crab. There is also a fringe formed by a few strong hairs. In the type shown, midway between these two, that of the Libellulidæ, the mask is arched, and the prehensile portion is divided into three nearly equal parts, the outer two of which are movable. With their closely applied, serrated edges, they remind one of the sides of a patent excavator, which take up everything found inside, after they are drawn together.

Respiration in dragon-flies is performed by the valvular apparatus, formed by three membranous plates, in connection with the duct or canal at the extremity of the abdomen. This apparatus—guarded from accident by the spinous processes mentioned, and in Libellula by strong hairs set at right angles to them in addition—causes alternately a strong inrush and an expulsion of water. The water, on being drawn in, comes in contact with the thin walls of the tracheæ, its oxygen is exhausted, and it is then expelled to admit a fresh supply. The currents resulting from these operations are easily seen, if the water in which the larvæ are placed is turbid or slightly muddy, as the particles are then observed to be drawn to and expelled from the tube. There are also the periodical expansions and contractions of the abdomen, in which the breadth is slightly increased and the length slightly lessened, indicating the regularity of the function if the currents cannot be seen. When lying quiet and undisturbed, these movements, I find, number about thirty-two to the minute, but should the insect be disturbed and excited they are much quickened. The power of this wonderful apparatus is twofold. It not only primarily carries on respiration, but at the same time it enables the animal to progress at pleasure by swimming as well as by crawling. Its method of swimming, however, is somewhat jerky, though swift, as the expulsions are not constant, there being a pause between every stroke of the internal piston for the inrush of water. The legs are not adapted for swimming, and do not assist in this mode of progression, being kept close to the sides of the body. On taking the larva out of the water for a little, the respiratory action immediately ceases, but on replacing it, the water is expelled or respired with much more force than usual—equal, I would suppose, to a gasping for breath, accompanied, on regaining the water, by a slight clicking noise. The larvæ, however, do not all respire in this way. In the Agrionidæ they do so by three flattened plates or false gills, very like leaves, attached to the extremity of the abdomen. Their edges, like leaves, are serrated, but only half-way down, with a sharp prickle or hair at each point. These plates are ramified by tracheæ which extract air from the water and convey it to the larger internal tracheæ. They also at the same time assist in locomotion. In Calopteryx they are excessively long, nearly equalling the abdomen.

An idea of the tenacity of life in the larvæ may be had from the fact, that after I had placed three, in different stages of development, in methylated spirit, for one hour, they regained their ordinary activity on being retransferred to fresh water, and lived thereafter for a couple of days until finally placed in spirit.

On the approach of the great transformation, the pupa of the dragon-fly crawls out of the water, and fixes itself by its claws to some water-plant or other object, and makes ready for the final ordeal. Within a longer or shorter time, the pupa-skin once more splits along the back; but on this occasion the mature and now winged insect struggles out, with the body weak and the wings damp, at first head downward, shortly assuming an erect position to extricate its lower extremity. On its defenceless condition the air and sun soon work wonders: the wings expand and stiffen, and in a little while, freed from the fetters of its former existence, it appears no longer a sluggish, grovelling creature, but the perfect insect, an active and beautiful denizen of the air, the glancing sunbeams giving now one colour, now another, to its burnished body.

Tennyson, who, with his keen observation of Nature's most delicate moods and changes, would have been a great naturalist if he had not been a great poet, has described its final transformation in his poem of the "Two Voices" in the following lines:—

> "To-day I saw the dragon-fly
> Come from the wells where he did lie.
>
> An inner impulse rent the veil
> Of his old husk: from head to tail
> Came out clear plates of sapphire mail.
>
> He dried his wings: like gauze they grew:
> Thro' crofts and pastures wet with dew
> A living flash of light he flew."

Reading these lines, one can almost imagine he feels the warmth of the sunshine, and sees the gauzy-winged tyrant of the insect world, with its hawk-like flight and extended vision, literally seeking whom it may devour, or hovering like a bird of prey to pounce upon its unsuspecting victim. It may be seen hunting for insects in the neighbourhood of pools, streams, and ditches in fine weather, during summer or autumn, or the male and female may be frequently seen in company—the latter being held by the neck with the "claspers" of the male—alighting on water-plants at the surface of the water to deposit their eggs, which they generally do in masses, and several well-authenticated instances are on record where the female has descended below the surface for this purpose. In dull weather it usually remains at rest on the leaves of plants, trees, &c., often on a particular spot, to which it always returns. They have been popularly termed "Devil's darningneedles," a distinct allusion to the elongated abdomen; also "Horse-stingers," from a notion that they attacked and stung horses,—but they have no sting, and are in this respect harmless. In France they are termed "Demoiselles," in allusion to their beauty; in Germany, "Water-virgins," and also "Gauze-flies."

The perfect insect has a round lengthened body, with large wings, and among the different species there is great diversity both in size and colour. There is also frequent dissimilarity in the colours of the male and female. For instance, the male of Agrion puella—a beautiful slender insect, measuring from 2 inches to 2½ inches across the wings—is azure blue, but the female is almost black. The specimen shown, in spirit, Agrion minium, from Balerno Moss, where I saw it in dozens, is of a brilliant scarlet colour, touched with black and yellow beneath, with black wings alike in size. Libellula depressa, about 2 inches long, is of a beautiful blue colour. Aeschna grandis, nearly 3 inches long and 4 inches in expanse of wings, is of a light yellow colour. The eyes in the largest species especially are simply marvels of colour, and the wings of many are curiously tipped with different hues. These beautiful tints, however, all vanish after death.

The head of the dragon-fly is comparatively small, and differently shaped in the different families. It is excavated posteriorly, and its connection with the prothorax is so slight that it almost turns on it as on a pivot. In front of the eyes is a portion termed the vertex, which sometimes (as in Libellulidæ) forms a swollen vesicle. The antennæ are minute, and generally smaller in proportion than in almost any other insects, consisting of only two short swollen basal joints, and a five- or six-jointed bristle-like thread. In some foreign species they are fairly prominent. The front of the head is vertical, and consists of a large, often dilated, upper portion, commonly termed the *nasus,* followed by a transverse portion termed the *rhinarium*, and this again by the large labrum, which conceals the jaws and inner mouth parts. The lower lip or labium is attached to a very small chin piece (or mentum), and is generally very large,—often (as in Agrionidæ) divided almost to its base into two portions, or more frequently entire or nearly so. On each side of the labium are two usually enormous hypertrophied pieces which form the "palpi," and which are often furnished at the tips with an articulated spine, or terminal joint, the whole structure serving to retain the prey.

The eyes of the dragon-fly are, as a rule, enormous, forming two rounded masses, often contiguous, which means that they extend all round the head, from one angle of the mouth to the other, and occupy a large proportion of its surface. In fact, many of them possess what mortals often covet—eyes on the back of their head. Sometimes they are widely distant, as in Agrionidæ and Gomphina. They are compound, being composed of innumerable hexagonal facets, of which as many as 12,544 have been counted in one eye. The chitinous skin which covers the whole body is continued over the eye as a transparent layer or cornea, and it is this that is so divided. On examination they are seen to be unequal in size, the facets being larger on the upper portion. Over and above these compound eyes, and aiding them largely in their function, there are three ocelli or simple eyes, and these when present, which they usually are, are placed on the forehead, looking in different directions and in the form of a triangle, thus giving the creature practically a complete circle of vision.

The prothorax is very small, and consists of only a narrow ring, the upper portion of which is frequently raised into lobes. The thorax, carrying the wings and legs, is large, and consolidated into a single piece, exhibiting, as it should, great strength. There are oblique sutures on the sides below the wings, and the portion in front of them, which is extremely strong, shows a median carina or keel above and a broad transverse sinus posteriorly.

The abdomen, compared with the other primary segments, is of great length, and varies considerably in form, the two extremes being the filiform structure seen in the Agrionidæ,—many of them being much thinner than a darning-needle,—and the broad and depressed form seen in Libellula depressa. It consists of ten distinct segments, whereof the basal two and those at the apex are short, the others lengthened, the first being excessively short. That of the male terminates in prehensory appendages known as "claspers," and these are sometimes so prominent as to have been taken for stings.

The internal structure of the dragon-fly is comparatively simple. The whole digestive apparatus consists of a canal extending from mouth to anus, comprising the gullet, stomach, and intestine, with some dilatations and constrictions. Placed round the posterior extremity of the stomach there are the Malpighian bodies, stated to number about forty. There appear to be no salivary glands.

Flight in the largest species is bold and rapid, and quite in keeping with their carnivorous instincts. In proportion to their size it is much more powerful than that of birds. The wings are four in number, and act similarly and simultaneously, in some species always expanded when at rest, in others folded up or laid together. They are long, comparatively narrow, equal in size or nearly so, very thin, gauze-like, and much reticulated, resembling the finest lace or network, this latter condition being the result of the interlacing of the numerous nervures which support the double membrane. Under the microscope they are seen to have a double row of tooth-like projections, giving them a serrated appearance round their edges, the nervures also being armed with minute spines. At the outer extremity, in most species, there is a curious dense patch termed the "pterostigma," but whether formed of nervous matter or for what use is not at present known. It forms an aid, however, in classification. Most species can remain for hours on the wing, when in pursuit of their prey, their speed being such, it has been said, as to elude chase by a swallow. As a proof of their staying power on the wing, a case has been cited where a dragon-fly flew on board a ship off the coast of Africa, the nearest land being 500 miles distant. The specimen shown, Aeschna cyanea, was caught on board the steamship City of Paris three miles off Sandy Hook, on one of her voyages from New York this last summer. They are noted for their easy and rapid evolutions, and are said to possess the remarkable power of flying in all directions if necessary without turning. This statement, however, after repeated watching, I have been unable to verify for myself.

Dragon-flies are possessed of six legs jointed to the under surface of the thorax, in three pairs close together. They are all alike in structure, and are directed forwards. When magnified, they are seen to be possessed of two strong claws, sometimes divided into four at the tips, and two rows of formidable-looking spines on the inner or under side of the leg.

Metamorphosis frequently induces remarkable changes in the system of nutrition of insects, but such is not the case with dragon-flies, further than that in the larval condition the food consists of aquatic insects, whereas in the mature form it consists of winged insects. They eat their prey completely, not contenting themselves by merely sucking its juices. An examination under the microscope of the contents of the digestive tube easily verifies this statement, there being found in every case the remains of heads, eyes, legs, wings, and antennæ—the indigestible portions being rejected as nearly dry pellets in the course of nature. The change, however, in the respiratory system, produced by metamorphosis, is sufficiently striking, being now carried on, as in many other insects, through direct contact with the air by means of spiracles, of which there are several pairs—two to each segment—close to each other, on the *under* side of the abdomen, where the dorsal and ventral surfaces really join. They are oval in form, and are supplied on both sides with a delicate fringe of hairs.

Many instances have been cited of the migration of dragon-flies. Some species are often seen at sea, far from land, in calm weather, in troops which are no doubt migratory: our common Libellula quadrimaculata, which inhabits the cold and temperate regions of the northern hemisphere, has been frequently seen in immense migratory swarms. At a certain season of the year the northern winds sweep a host of a species into Havannah and its environs. Kirby & Spence, in their introduction to 'Entomology,' note the following instances: "Meinecken states that, on a clear day, he once saw in a village in Anhalt, about 4 in the afternoon, such a cloud of dragon-flies (Libellula depressa) as almost concealed the sun, and not a little alarmed the villagers, under the idea that they were locusts." Mr Woolnough of Hollesley, in Suffolk, once witnessed such an army of the smaller dragon-flies (Agrion) flying inland from the sea as to cast a slight shadow over a field of four acres as they passed. But the greatest on record are perhaps those witnessed in 1816 and in May 1839, when cloud-like swarms were seen at Weimar, Göttingen, &c. As illustrative of the swarms in which they appear, and of the use to which they may be put, Alfred Russell Wallace states, in his book on the Malay Archipelago, that in Lombock, an island at the east end of Java, "every day boys were to be seen walking along the roads and by the hedges and ditches, catching dragon-flies with bird-lime. They carry a slender stick with a few twigs at the end well anointed, so that the least touch captures the insect, whose wings are pulled off before it is consigned to a small basket. The dragon-flies are so abundant at the time of the rice-flowering that thousands are soon caught in this way. The bodies are fried in oil with onions and preserved shrimps, or sometimes alone, and are considered a great delicacy."

The following extract from Mr W. H. Hudson's 'Naturalist in La Plata,' regarding the habits of dragon-flies under certain conditions, will be found most interesting:—

One of the most curious things I have encountered in my observations on animal life relates to a habit of the larger species of dragon-flies inhabiting the Pampas and Patagonia. Dragon-flies are abundant throughout the country wherever there is water. There are several species, all more or less brilliantly coloured. The kinds that excited my wonder, from their habits, are twice as large as the common widely distributed insects, being three inches to four inches in length, and, as a rule, they are sober coloured, although there is one species—the largest among them—entirely of a brilliant scarlet. This kind is, however, exceedingly rare. All the different kinds (of the large dragon-flies), when travelling, associate together; and occasionally, in a flight composed of countless thousands, one of these brilliant-hued individuals will catch the eye, appearing as conspicuous among the others as a poppy or scarlet geranium growing alone in an otherwise flowerless field. The most common species—and in some cases the entire flight seems to be composed of this kind only—is the Aeschna bonariensis Raml., the prevailing colour of which is pale blue. But the really wonderful thing about them all alike is, that they appear only when flying before the south-west wind, called *pampero*—the wind that blows from the interior of the pampas. The pampero is a dry, cold wind, exceedingly violent. It bursts on the plains very suddenly, and usually lasts only a short time, sometimes not more than ten minutes; it comes irregularly, and at all seasons of the year, but is most frequent in the hot season, and after exceptionally sultry weather. It is in summer and autumn that the large dragon-flies appear, not *with* the wind, but—and this is the most curious part of the matter—in advance of it; and inasmuch as these insects are not seen in the country at other times, and frequently appear in seasons of prolonged drought, when all the marshes and water-courses for many hundreds of miles are dry, they must, of course, traverse immense distances, flying before the wind at a speed of seventy or eighty miles an hour. On some occasions they appear almost simultaneously with the wind, going by like a flash, and instantly disappearing from sight. You have scarcely time to see them before the wind strikes you. As a rule, however, they make their appearance from five to fifteen minutes before the wind strikes; and when they are in great numbers, the air to a height of ten or twelve feet above the surface of the ground is all at once seen to be full of them, rushing past with extraordinary velocity in a north-easterly direction. In very oppressive weather, and when the swiftly advancing pampero brings no moving mountains of mingled cloud and dust, and is consequently not expected, the sudden apparition of the dragon-fly is a most welcome one, for then an immediate burst of cold wind is confidently looked for. In the expressive vernacular of the gauchos the large dragon-fly is called *hijo del pampero*—son of the south-west wind. It is clear that these great and frequent dragon-fly movements are not explicable on any current hypothesis regarding the annual migrations of birds, the occasional migrations of butterflies, or the migrations of some mammals, like the reindeer and buffalo of Arctic America, which, according to Rae and other observers, perform long journeys north and south at regular seasons, "from a sense of polarity." Neither this hypothetical sense in animals nor "historical memory" will account for the dragon-fly storms, as the phenomenon of the pampas might be called, since the insects do not pass and repass between "breeding and subsistence areas," but all journey in a north-easterly direction; and of the countless millions flying like thistle-down before the great pampero wind, not one solitary traveller ever returns.

The cause of the flight is probably dynamical, affecting the insects with a sudden panic, and compelling them to rush away before the approaching tempest. The mystery is that they should fly from the wind before it reaches them, and yet travel in the same direction with it. When they pass over the level, treeless country not one insect lags behind, or permits the wind to overtake it; but, on arriving at a wood or large plantation, they swarm into it, as if seeking shelter from some swift-pursuing enemy, and on such occasions they sometimes remain clinging to the trees while the wind spends its force. This is particularly the case when the wind blows up at a late hour of the day; then on the following morning the dragon-flies are seen clustering to the foliage in such numbers that many trees are covered with them, a large tree often appearing as if hung with curtains of some brown glistening material, too thick to show the green leaves beneath.

In Patagonia, where the phenomenon of dragon-fly storms is also known, an Englishman residing at the Rio Negro related to me the following occurrence which he witnessed there. A race-meeting was being held near the town of El Carmen, on a high exposed piece of ground, when, shortly before sunset, a violent pampero wind came up, laden with dense dust-clouds. A few moments before the storm broke, the air all at once became obscured with a prodigious cloud of dragon-flies. About a hundred men, most of them on horseback, were congregated on the course at the time, and the insects, instead of rushing by in their usual way, settled on the people in such quantities that men and horses were quickly covered with clinging masses of them. My informant said—and this agrees with my own observation—that he was greatly impressed by the appearance of terror shown by the insects: they clung to him as if for dear life, so that he had the greatest difficulty in ridding himself of them.

There is a curious legend regarding this insect which clings to the Japanese emperor, Yuriyaku Tenno, who flourished in 457 A.D. He was making an imperial progress to the moor of Akizu for the purpose of hunting. As he sat down to rest, a horse-fly bit his august arm; but immediately a dragon-fly came and seized the horse-fly and flew away. Thereupon he composed an august song as follows:—

Who is it tells in the great presence that game is lying on the peak of Womurs at Mi-Yeshinu? Our great Lord who tranquilly carries on the government, being seated on the throne to await the game, a horse-fly alights on and stings the fleshy part of his arm, fully clad in a sleeve of white stuff, and a dragon-fly quickly eats up the horse-fly. That it might properly bear its name, the land of Yamato was called the Island of the Dragon-fly.—'Japan,' by David Murray.

The latest alteration in classification of these neuropterous insects has been made by Fabricino, one of the great entomologists of the eighteenth century, who raised the dragon-flies from the position of the genus Libellula of Linnæus to the importance of a distinct order named by him Odonata. The Odonata are divided into two sections—Libellulina and Agrionina—the former being again divided into two tribes; the whole order being subdivided into seven families and forty-five species (as shown in the table on p. 14).

The distribution of the dragon-flies is world-wide, excepting, of course, in the polar regions; but they are especially insects of the torrid zone. About 1700 species are said to be now known, relegated to the several sub-families as follows: Agrionina, 490 species; Calopterygina, 170; Gomphina, 210; Aeschnina, 150; Cordulina, 100; Libellulina, 580. In Europe, only 100 species have been observed, and 45 of these occur in Britain. In Australia they are very numerous—the reverse being the case in New Zealand, where only 8 species are known.

BRITISH DRAGON-FLIES—ODONATA.

Section I.—**LIBELLULINA.**					Section II.—**AGRIONINA.**	
Tribe 1.—**Libellulinæ.**		Tribe 2.—**Aeschninæ.**				
Family 1. LIBELLULIDÆ.	Family 2. CORDULIDÆ.	Family 3. GOMPHIDÆ.	Family 4. CORDULEGASTRIDÆ.	Family 5. AESCHNIDÆ.	Family 1. CALOPTERYGIDÆ.	Family 2. AGRIONIDÆ.
Genera.	*Genera.*	*Genera.*	*Genera.*	*Genera.*	*Genera.*	*Genera.*
1. Platetrum 1	1. Somatochlora 1	1. Onychogomphus 1	1. Cordulegaster 1	1. Anax 1	1. Calopteryx 2	1. Lestes 5
2. Libellula 2	2. Cordulia 1	2. Gomphus 2		2. Brachytron 1		2. Platycnemis 1
3. Orthetrum 2	3. Oxygastra 1			3. Aeschna 6		3. Ettnalagma 1
4. Leucorrhinia 2						4. Agrion 3
5. Sympetrum 6						5. Ischnura 2
						6. Pyrrhosoma 2
						7. Erythomma 1
Species 13	3	3	1	8	2	15

Total species . 45

Among fossil insects dragon-flies are said to hold a prominent position, and their remains appear to be numerous. In Britain they have been found more especially in the Purbeck Beds of Swanage and the vales of Wardour and Aylesbury, &c.; but the richest strata are those of the Upper Miocene at Œningen, in the Rhine Valley, the Middle Miocene at Radaboj, in Croatia, and more especially the celebrated limestone long quarried for the light-yellow porous lithographic stone at Solenhofen, near Munich. The excessive fineness of grain of this last deposit has enabled it to preserve in the most marvellous perfection abundant remains of animal life, both of sea and land. It is said to be of marine origin, although this is doubted. The remains of gigantic dragon-flies found in it are numerous and perfect, even to the lace-work of their wings. But it is remarkable that no traces of their larval condition have been found, although discovered in most of the other strata; hence the insects have been regarded as having been drowned in the sea or a lake and washed ashore.

List of Microscopic Slides prepared by the Author to Illustrate the above Paper.

1. Mask of larva, 1st type.
2. " " 2d "
3. " " 3d "
4. Head and mask of larva.
5. Respiratory canal and spinous processes.
6. " "
7. Gizzard of larva.
8. " "
9. Tracheal tubes and Malpighian bodies.
10. Antennæ of larva.
11. Gill leaf-plates of larva, Agrionidæ.
12. Immature wings " "
13. Compound eye of Aeschna.
14. Ocelli (simple eyes) "
15. Mouth-organs "
16. Spiracles "
17. Forelegs "
18. " Agrion.
19. Wing, Aeschna.
20. " Agrion puella.
21. " " minium.
22. Reproductive organs and "claspers," male.

Objects in Spirit, &c.

1. Cast skins of larvæ, 1st type, Aeschnidæ, 2 specimens.
2. Larva, 2d " Libellulidæ.
3. " 3d " Agrionidæ.
4. Eggs.
5. Dragon-fly, Agrion minium.
6. " two species from foot of Ben Lawers.
7. Six foreign dragon-flies from Demerara.
8. Six specimens British Aeschnina and Libellulina.

II.—*ON THE GROWTH OF LEAVES.*

BY T. B. SPRAGUE, M.A., LL.D., &c., PRESIDENT.

(*Read Dec. 23, 1891.*)

To the student of natural history, who is also a mathematician, it is a matter of interest to investigate the exact laws and processes according to which organisms grow. In some cases where an organism grows for many years, we are able to trace without difficulty the several stages of growth—as, for instance, in the rings of a dicotyledonous tree. Instances of a different kind, but illustrating the same principle, are found in land and sea shells of various kinds; in each case the new year's growth being added to the old shell in a way which is easy to trace. In other cases the process of growth is not so obvious; for instance, the growth of the human skull takes place by each of its component parts receiving additions along the sutures. The bones of mammals grow according to laws which are now well understood, and are easily investigated in consequence of the discovery accidentally made, that, when an animal has madder mixed with its food, the new bone growth, which is ordinarily white, becomes a pink colour; so that, by giving an animal alternately food that contains madder and food that is free from it, the bones will contain pink and white layers alternately.

As a contribution to the general subject, I propose to mention to the Society an observation I have made this summer on the growth of the leaves of some garden flowers. In Henfrey's 'Elements of Botany' I find two kinds of growth of leaves described, which he calls *basipetal* and *basifugal.* He says (p. 599, third edition)—

> As a rule, the first part of the leaf formed is its point, which is gradually pushed out by development at the point of junction of leaf and stem. The apical growth of the leaf is generally soon arrested. . . . The pushing-out of the leaf by development at its base may be well observed in the leaves of Hyacinth-bulbs developed in early spring. . . . The basilar or *basipetal* mode of leaf-formation above described is that which is most frequent; but in some instances the apex of the leaf, instead of early losing its power of growth, continues to grow and develop new cells in that situation, the cells at the base of the leaf, in these cases, being the oldest. This mode of leaf-formation is called *basifugal.*

In several leaves which I have observed, a third kind of growth takes place, which is quite different from either of these, notably in the garden nasturtium (Tropæolum). By comparing the young leaves with the oldest that can be got at the end of summer, which are several times larger in linear magnitude, I find that the venation of all the leaves is exactly the same, and I infer that the growth has taken place by the stretching of each particle of the leaf. The process may be compared to that which would take place if we took a square inch of thin indiarubber, and stretched it to double its length and double its breadth. It is very marked in the so-called horse-shoe geraniums. I believe a similar process takes place in a great number of leaves, among which I will only instance that of the Butterburr (*Petasites vulgaris*).

III.—*VEGETABLE FIBRES USED IN BRUSH-MAKING.*

By Mr THOMAS WRIGHT.

(*Read Dec. 23, 1891.*)

The staple article used in the brush trade is bristles—*i.e.*, hairs of the wild boar. Russia is the chief source of supply, but it is also gathered in America, China, Turkey, Greece, and nearer home in the forests of Germany and France. Horse-hair is freely used; and, for special purposes, badger, sable, goat, and squirrel hair are in constant request.

As the supply of bristles is now decreasing, and the demand for brushes increasing with civilisation, makers have been constrained to introduce vegetable fibres as substitutes for animal hairs. For many purposes these fibres are quite suitable, but they are much inferior to bristles, owing to *lack of elasticity.* Bristles have a remarkable power of springing back to their original straightness after being crushed, and it is this native elasticity which makes them so useful. If vegetable substitutes could be endowed with this property, their value would be increased tenfold.

The following list comprises all the vegetable fibres generally used in the brush trade:—

1. *Mexican Fibre.*—This is obtained from the leaves of Agave heteracantha, a plant which grows abundantly in a temperate region of Mexico, twenty days' journey from the port of Tampico. The natural colour of the fibre is white, but it takes on dye readily, and when mixed with bristles it is difficult to detect its presence. It has the power of resisting the action of water, and consequently does very well when made into nail- and scrubbing-brushes. For sweeping purposes it is useless.

2. *Kitul Fibre.*—This is obtained from the leaf-stalks of Caryota urens, a palm-tree which grows in India and Ceylon. It is a very tough and durable material, deserving to be more used than it generally is.

3. *Cocoa Fibre.*—As every one knows, this is a product of the husk of the cocoa-nut, from the palm Cocos nucifera.

4. *French Whisk.*—This fibre is the *root* of a grass—Crysopogon gryllus. Although known as French whisk, it is mostly grown in Italy. The roots are washed in running water, dried in the open air, and then bleached with sulphur-fumes. This material is used in making carpet-brushes, and dandy—*i.e.*, dandriff—brushes for grooming horses. The tender rootlets are made into clothes-brushes.

5. *Mexican Whisk.*—This resembles French whisk in appearance, and is used for similar purposes, but is not so durable. It is the roots of Epicampes macroura.

6. *Italian Millet.*—This is the fruiting-spike of Sorghum

vulgare. Carpet-switches of the cheaper kind are made of this product, and shipped from Venice to England.

7. *American Millet.*—This is the fruiting-spike of Sorghum saccharatum. It is commonly known in the States as broom corn. According to American tradition, all the millet in the country is the progeny of one seed taken by Benjamin Franklin from a hand-whisk which a lady had brought from the East. Superior carpet-switches are made from the tops of this plant.

8. *Bahia Bass.*—This fibre is obtained from the leaf-stalk and sheathing base of Attalea funifera, a Brazilian palm-tree. It is the best material in the market for stable- and street-brooms, but the supply has diminished of late. The fruit of this tree is called the Coquilla nut, and is used by turners for making knobs, buttons, and articles of ornament.

9. *Monkey Bass.*—This is obtained from the leaf-stalks of Leopoldina piassaba, a palm-tree which grows in the north of Brazil. It is collected by the natives, piled on rafts, and floated down the Amazon to the harbour of Para. Scrubbing- and dandy-brushes are filled with this fibre.

10. *African Bass.*—This fibre is simply the midribs from the leaves of a bamboo palm, Raphia vinifera, a tree widely distributed over Africa. Although this material is not so tough as Bahia bass, it is well adapted for stable-brooms, and large shipments come from the Gulf of Guinea.

11. *Bassine.*—This is also used for stable-brooms, and is obtained from an Indian tree, the Palmyra palm, Borassus flabelliformis. It is a durable fibre, but becomes very crooked when quite dry,—rather a serious drawback.

12. *Patent Bass.*—Bamboo cane from the Malay Islands is sold under this name. It is a cheap commodity, and makes very inferior brooms.

13. *Rattan Cane.*—This is used to a limited extent in the manufacture of stable - brooms. It is obtained from Calamus verus.

14. *Madagascar Fibre.*—This is often mixed with other fibres for the purpose of making scrubbing-brushes. I do not know its botanical source—probably obtained from the leaves of an Agave.

These materials are generally imported in the rough condition, and are prepared for brushmakers by "dressers" in London, Manchester, and Glasgow. Firms engaged in this branch of business have shown commendable enterprise in the introduction of new materials, and have gathered botanical products in every part of the globe—from Siberia to Ceylon, from China to Peru.

IV.—*THE SACRED PLANT OF THE DRUIDS.*

By Dr WILLIAM WATSON.

(*Read Jan. 27, 1892.*)

The object of this paper is to show that two plants have been confounded under one name. One is the mistletoe (*Viscum album*) of the English, the Germans, and the Scandinavians—the plant sacred to Balder, the sun-god, and worshipped at the solar festival of Yule, when the day, which for six months had gradually got shorter and shorter, at last began to lengthen again. The other is the sacred plant of the Druids,—the priests of the ancient Gauls and Britons; a plant which was cut by them from oak-trees in the depth of the forest, the priests themselves being crowned with garlands of oak-leaves, so that it must have been cut in summer or autumn, not in winter or spring. It is, of course, possible that two races so unlike as the Celts and Saxons had one and the same sacred plant, but it is not probable. We know how different they are now. The Gaelic language is so difficult that no English speaker can get his tongue round it. Celtic ideals of religion and government are unintelligible or repulsive to the Saxon. Cæsar tells us that in his time the two races were as different as they are now. He says the Germans differ from the Gauls in speech, religion, manners, and customs. He particularly mentions that the Germans have no Druids—"neque Druides habent." Yet on the common theory adopted by Linnæus, that the mistletoe was the same as the sacred plant of the Druids, the Germans certainly ought to have had Druids among them. Pliny tells us that the sacred plant of the Druids grew on the oak. Now the mistletoe, which is associated with the English festival of Yule, does not grow on the oak. It generally grows on the crab-apple tree, but it is also found occasionally on the thorn, poplar, willow, ash, maple, and lime. It never grows on the oak, except in the Edinburgh Botanic Garden, where a plant has with difficulty been made to grow artificially on the oak; but it never does so naturally. The word "mistletoe" is Saxon, not Celtic, and is connected with the name of the bird, the missel-thrush.

What, then, was the sacred plant of the Druids, cut by them from oak-trees in summer or autumn? I have not the slightest doubt that it was the Beef-steak fungus (*Fistulina hepatica*), which never grows on any tree except the oak, or the chestnut, which is a near botanical ally of the oak. Dr William Craig of Edinburgh lately read a paper to the Botanical Society on one which grew on a chestnut in his garden; but to see this plant growing in perfection all interested ought to visit Lockwood, near Moffat, in the month of September. The old oaks are covered with magnificent specimens. The plant, when cut, pours out a fluid like blood, and the Druids no doubt worshipped it on that account. Cæsar tells us that human sacrifices were common in Gaul, and the Druids seem to have thought that the blood of this plant was pleasing to their savage gods, just as the blood of human beings was pleasing to them. If the Druids were also cannibals, they no doubt ate the plant, as they perhaps ate the flesh of their human victims. They certainly ate the flesh of the beasts they sacrificed. The Beef-steak fungus is perfectly edible. I have eaten it, and rather like it, although it is not so nice as the delicious Hydnum repandum, or even as the Cantharellus cibarius—the best and second-best of edible fungi found in Scotland. I cannot believe that anybody ever ate the mistletoe, and Frazer, in his "Golden Bough," has shown us that no sacrifice was complete unless the priest and worshippers ate the victim. The English mistletoe was a mere tribute or present to the gods. The Beef-steak fungus was emblematic of a true sacrifice; and Cæsar, who tells us in Book VI., chap. 15, that the Gauls sacrificed human beings to the gods, tells us in chap. 19 that the Germans offered no sacrifices of any kind. We have the same distinction in India. The followers of Siva sacrifice animals to their god, which are afterwards eaten by priests and people. The followers of Vishnu present flowers only at his temple, and many of them refuse to enter a temple of Siva, which has, according to them, been polluted with the blood of beasts.

The Druidical festival was certainly in summer or autumn. Most probably it is represented by the modern festival of Hallowe'en, on October 31, half a year after the spring festival of Beltane, on the 3d of May,—a Celtic festival, which was originally quite distinct from the English festival on May-day. At Beltane we know that human beings were actually sacrificed on the hill-tops. At Hallowe'en it is probable that the blood of the Fistulina was held as equivalent to actual human blood, and that no real man or woman was put to death. Of course these dates were determined by the entrance of the sun into particular constellations of the zodiac, and not on our system, which essentially depends on the date of the equinox—a phenomenon which the Druids could not have determined with sufficient accuracy. Probably Beltane corresponded with the entrance of the sun into Taurus, and Hallowe'en with the entrance into Scorpio.

In conclusion, I believe, as I have already stated, that the sacred plant of the Druids was the Beef-steak fungus, *probably* associated with the Celtic festival of Hallowe'en; and that the sacred plant of the English was the mistletoe, *undoubtedly* associated with the English festival of Yule.

At this meeting Mr Hugh Fraser read a paper on the true Cedars—viz., the Cedar of Lebanon (*Cedrus Libani*), the Himalayan Cedar (*C. Deodara*), and the Algiers Cedar (*C. atlantica*). Branches from these trees were exhibited, their habits pointed out, and their claims to rank as separate species discussed. Reference was also made to several other of the Coniferæ which are popularly, though erroneously, termed cedars.

V.—*THE MICE PLAGUE.*

By Mr TOM SPEEDY.

(*Read Jan. 27, 1892.*)

It was with great pleasure that I heard of the appointment of a Commission to inquire into the cause of the vole plague, as I hoped that some new facts in Natural History might be elicited thereby. In this, however, I have been disappointed. The outcome of the Commission's work is a recommendation "that weasels, which do little damage to game—at least in moorland and hill pasture—should not be molested." As to the preservation of weasels being recommended, I have little to say, but the statement that they "do little damage to game" simply indicates lamentable want of knowledge on the part of those by whom the Commission has been misled. I have known, personally, an entire brood of blackgame destroyed by a weasel; and there are few gamekeepers of experience who could not corroborate this from observation. In illustration of its bloodthirsty character, I may mention that a neighbour's boys had a pair of rabbits confined in a house with a brood of eight young nearly half-grown, and a second litter, seven in number, about ten days old. Hearing a noise one evening in the rabbit-house, the boys went to ascertain the cause. On opening the door a weasel made its exit by a small hole, and effected its escape. It was found, however, that the whole of the young rabbits, fifteen in number, had been killed, the speck of blood behind the ear of each revealing the cause. The noise which attracted attention was caused by the old rabbits defending themselves; but there can be no doubt that, had attention not been attracted, they too would have shared the fate of their progeny.

Coming to winged vermin, it is stated in the report that owls and kestrels are "harmless," but are beneficial to agriculturists by killing large numbers of voles. In so far as they devour mice, beetles, and caterpillars, they work in the interest of the farmer; but these are by no means to be regarded as their exclusive food. As to their killing and devouring voles there is not the slightest doubt, but that they are harmless to game I confidently dispute. In regard to tawny owls, I have repeatedly stated in the public prints that they are not only destructive to game, but to pigeons and to all singing-birds. In the spruce woods on the Ladykirk estate in Berwickshire, I have seen young pigeons carried to the owlets, and at a bedroom window at night have heard the noise made by small birds being lifted from their roosting-place among ivy by tawny owls. I have never seen rats brought to the owlets, but I have it on the authority of those on whose word I can rely that young rats are also included in their bill of fare.

In the month of January last, Mr Cameron, head game-keeper to His Grace the Duke of Argyll, found a number of pheasants killed, and partly devoured, in the pheasantry, which consisted of a few acres of scrub, fenced with net wire ten feet high. The hen birds were pinioned, but cocks could fly in and out at will. Thinking rats were the depredators, he resorted to every available expedient to destroy them. After a fall of snow one morning, he found a pheasant had been killed and partly eaten during the night. Observing where the scuffle had taken place among the newly-fallen snow, he discovered that the pheasant had been killed by a bird, and at once suspected owls. He therefore set a trap at the remains of the pheasant, and also had a post put in the ground, on the top of which he placed a pole trap. Early in the evening a couple of tawny owls were secured, one in each trap. That owls are destructive to all kinds of small birds and to young game is well known, but I must confess I was not prepared to believe that they would attack and kill adult pheasants. Were it not that the high character and veracity of Mr Cameron are unimpeachable, I should have hesitated to accept such a statement.

Owls being plentiful at The Inch, I have frequently removed the young ones from the nest and placed them in a box, for the express purpose of discovering the character of the food brought by the parent birds. A popular notion prevails that owls cannot see in daylight, and that they hunt for their prey only in the dark. While this may be their normal habit at other seasons, it is very different when they have to provide food for their young. On one occasion, an hour after I had put the owlets into the box, and though only three o'clock in the afternoon, I discovered that a young rabbit, minus the head, but quite warm, had been placed beside the young birds. On visiting them next morning, I found that every bit of the rabbit—flesh, skin, fur, and bones—was devoured, and that mice, blackbirds, thrushes, chaffinches, yellow-hammers, sparrows, and other small birds are included in their bill of fare. As is well known, owls, like most predatory birds, eject bones, fur, feathers, and other indigestible parts of their food, in the shape of an oblong bolus. On dissecting some of these castings found under a cedar-tree in the garden at The Inch, I discovered quantities of the fur of rabbits and mice, with the feathers, feet, bills, and bones of the birds referred to, as well as the remains of beetles. Having had observations taken in different parts of Scotland as to the food of tawny owls, I have found that it consists of young pigeons (wild and tame), young pheasants, partridges, grouse, a large number of the small birds already mentioned, with a young mallard as an occasional treat, young rabbits, small leverets, a large number of mice, and a few small rats.

Reverting to the young birds in confinement, on going near the box the old ones would frequently attack a person, striking, like the Irish assassin, from behind. With my coat neck up, and my hat well drawn down, they could not hurt me, but I scarcely could have believed that an owl could strike my back and shoulders with such violence. While out with my gun one evening to shoot some rats for my pet kestrels, I passed the box where the owls were confined. After a few defiant threatenings from different trees, the male bird flew to attack me, making straight for my face. When within eight or ten feet, he seemed so resolute in his purpose that I threw the gun hurriedly upwards and backwards with the view of scaring him, or striking to protect my face if he should persist in his attack. Unfortunately, at that moment the female was approaching me from behind, and as the gun was thrown quickly backwards, prior to bringing it down to strike the male, it met the female with such violence that it knocked her to the ground. She was only stunned, however, and quickly getting up, flew on to an adjoining tree. From the number of feathers on the ground and adhering to the muzzle of the gun, I feared she must have been badly injured. For two days she was never seen, but on the third I was pleased to see her return to watch over her imprisoned progeny. The male bird never actually touched my face, but flew up into a tree, and, in "hoolet" language, denounced me in terms, no doubt, more expressive than polite.

I must confess to my ignorance of the habits of the short-eared owls until the outbreak of the vole plague. I have frequently come across them when partridge-shooting in turnip-fields and rough pasture-land in the winter months, but, save on one occasion, at Dalnaspidal in Perthshire, I have never seen them in summer. While "studying" the vole plague in Ettrick Forest, I took a couple of young short-eared owls and carried them home for the purpose of finding out about their habits. It has been demonstrated beyond all doubt that in whatever part of the world a plague of mice appears, short-eared owls, impelled by a powerful instinct, are sure to follow and devour them. Sir Herbert Maxwell, in a letter to the 'Scotsman,' stated that "they are perfectly harmless to game." From their savage nature, I had grave doubts about this, and more especially as I had read the opinions of recognised authorities on the subject. Mr St John, in his well-known book, 'Wild Sports and Natural History of the Highlands,' says: "I saw a short-eared owl hunting a rushy field and regularly beating it for prey at mid-day. . . . He put up and made a dash at a snipe, but did not follow up his pursuit, probably perceiving that it would be useless." The short-eared owl has frequently been known to breed in the Orkney Islands. Mr Low, in his 'Fauna Orcadensis,' refers to it as "breeding in the hills of Hoy, where it builds its nest among the heath. It is there," he adds, "of great boldness, and has been seen to chase pigeons in the open day. In a nest containing young I found the remains of a moor-fowl and two plovers beside the feet of several others." In view of these statements I resolved to make some experiments. Having my two short-eared pets in an aviary, I introduced beside them live pigeons, partridges, and missel-thrushes, when, as is characteristic of the owl tribe, they decapitated their victims preparatory to making a meal of them. I was so struck with the savage aspect of these owls that I did not think they would discriminate betwixt a vole and a small weasel, more especially as they are nearly of the same size. I therefore resolved to try further experiments, so shutting the owls in a room about fifteen feet square, and procuring half-a-dozen weasels, I put them all together, feeding them chiefly on sparrows. On entering the room hurriedly, one of the owls flew on to his perch with a weasel in his talons, and within a week three of them were devoured by the owls. It ought to be added, however, that the remaining three weasels and the owls lived together for some time without interfering with each other. I do not base any theories on experiments which dissociate wild creatures from their natural environments and place them in captivity; but this incident, though not to be accepted as conclusive, affords presumptive evidence that weasel preservation and owl preservation are by no means synonymous terms.

The short-eared owl has always been regarded as migratory, though, as is well known, an occasional nest has been met with. In all my peregrinations over Scotland in the spring months, prior to this year, I was never fortunate enough to find a nest, though I have seen young birds in the month of August at Dalnaspidal. This bird generally arrives from the Continent in October, leaving our shores again in March. It is never seen in wood, but confines itself entirely to the open ground, breeding in the heather like a grouse, and laying from eight to twelve eggs, about the same size and colour as a pigeon's. Commencing to incubate as soon as the first eggs are dropped, the young birds in consequence come out in various stages, those first hatched being seen stalking about like young curlews among the heather, while the younger members of the family, in their dress of down, remain in the nest.

When the vole plague was at its height on the Border pasture-lands, short-eared owls remained and bred, as many as six, eight, and ten nests being found by the shepherds on their respective hirsels in Ettrick Forest. As I stated to the Commission of Inquiry, it is to these birds and rooks that we must look for the cure of the vole plague, otherwise than climatic influence. As some of the infested districts were many miles away from the woods which are the habitat of our native owls, to those who have observed the frequency of their visits with food to their young it is scarcely conceivable that they would fly such long distances. It must therefore appear manifest that, however plentiful, they would never be instrumental in clearing off the voles. It is otherwise with the short-eared species. Following the voles, they nest in the midst of them, and with such a large family to provide for, and breeding more than once in a year, it is easy to see how quickly they would decimate them. Approaching to about four yards of a nest, I was interested in observing a young vole within a foot of an owl sitting on her eggs. Her bright yellow eyes, however, were too intent watching my movements to notice the tiny creature. Going a step closer she flew off, leaving ten eggs exposed to view. There was practically no nest, the eggs being on the bare ground beside a bush of heather, with nothing to protect it from the rays of the sun. Unlike other owls, this species does not dislike bright sunshine, as I observed a pair of them in my aviary continually basked in the sun, while beside them a pair of long-eared owls shunned the light, and roosted in the darkest corner.

A great deal is said in the report of the Commission of Inquiry regarding the kestrel, and a gamekeeper is held up to ridicule because he killed one which he asserted was an "enemy to game." This bird has always been a special favourite, for who does not love to see it hover? Years ago I wrote pleading for its preservation, even though I had shot one in the act of carrying a young partridge. Seldom having found anything but mice, beetles, &c., in their crop and gizzard, that act has long since been forgiven. Two summers ago, when spending a day at Abington, in Lanarkshire, I had a conversation with the gamekeepers regarding the destructive habits of various kinds of hawks, and, as I always do, I pleaded for the protection of the kestrel. The underkeeper, a young lad, replied, "It's no use arguing with me; come to the hill, and I'll show you." I went, and he showed me the remains of a number of young grouse at a kestrel's nest. In a recent peregrination over a moorland district in Perthshire I saw a number of kestrels hovering in the air. Pointing one out to the keeper of Loch Kenard, who accompanied me, he said, "We have few about, but I don't like to touch them, although they do kill young grouse when providing for their nestlings. Still," he added, "we have a good many mice on the hills, and the good the kestrels do in killing them counterbalances the damage done to the grouse." On a grassy knoll we found a number of ejected pellets, but were unable to discover whether they were those of kestrels or owls. Carefully dissecting them, we observed the long fur of the rabbit, as well as the remains of mice.

It is owing to the endeavours of naturalists to prove too much that they are often not listened to. What is the good of their telling keepers that kestrels will not kill young game, when many of them have shot these birds in the act? The Duke of Athole, and many other Highland proprietors, give strict orders to their keepers that eagles and the rarer species of the hawk tribe are not to be interfered with, but they do not give as a reason for such instructions that these birds are "harmless to game." I can testify how loyally these orders are observed, and with what pride the keepers have escorted me to an eagle's eyrie, despite the fact that, amongst the heterogeneous remains of all manner of winged and four-footed game, newly killed grouse were to be seen neatly plucked, as if by the hands of a professional cook.

In hunting districts, foxes, though the greatest enemies to game, are preserved by the gamekeeper, and why, I ask, should owls, kestrels, &c., not be treated in a similar manner? Would it not be better to paint them in their true colours, and say, in the words of Mrs Manley,—

> "Smile on their work; be to their merits kind,
> And to their faults, whate'er they are, be blind"?

VI.—*THE EARTH PYRAMIDS OF THE AUSTRIAN TYROL.*

By Mr SYDNEY KEITH.

(*Read Feb. 24, 1892.*)

One evening in the spring of 1890 I was looking over a collection of photographs taken by a friend now deceased, and was much interested in several pictures of the earth pyramids in the Austrian Tyrol. Having made inquiries as to their whereabouts, I determined to have them photographed sooner or later. I had for some time meditated a Continental trip, and as 1890 was the year of the passion-play at Oberammergau, I decided to see the play and extend my tour in order to procure some pictures of the earth pillars. Accordingly, when the month of June came round I started for my holiday *viâ* Paris and Zurich, *en route* for Innsbruck.

It is not my intention to go into details regarding my journey, but I cannot refrain from mentioning the Brenner Pass, between Innsbruck and Botzen. It is the lowest pass over the Alps from Germany into Italy. The railway was opened in 1867, and, in the words of Baedeker, "it is one of the grandest works of its kind." The steepest gradient is 1 in 40, and in other places is 1 in 44. At certain places near Gossensass one could almost drop a stone on the next station several hundred feet below.

Botzen is pleasantly situated on the confluence of two rivers—viz., the Eisack and the Talfer; and, standing at an elevation of 880 feet above sea-level, is a town of considerable importance, with a population of about 11,000 inhabitants. It was the chief depot of traffic between Venice and the north, and is a capital centre for various excursions round about, especially for that wonderful country of the dolomites which I hope to visit at some future period. On the evening after my arrival at Botzen I had the good fortune to see the sun setting on the Rosengarten. This is a sight which must be seen to be appreciated, and cannot be adequately described. During the night a shower of snow fell, and in the morning the view from my bedroom window was lovely in the extreme, the red colour of the ferruginous rocks contrasting brilliantly with the virgin whiteness of the untrodden snow.

After making inquiries as to where the best group of the earth pillars was to be obtained, and getting several routes described to me, I fixed upon the Ritten. When the morning arrived for my climb up the Ritten, the weather was all that could be desired; so, having made a good breakfast, I strapped on my knapsack containing the camera, &c., and besides a changing box, the former weighing 18 lb. and the latter 9 lb. I also took my aneroid barometer and

THE EARTH PYRAMID VALLEY.

compass, which I have always found useful in travelling. I started just as the neighbouring clock chimed half-past eight. To look at it from a distance, my destination did not seem much of a climb, but when I came to try it with 27 lb. under a hot sun it meant pretty hard work. I had walked up till about 11 o'clock, and had not got much encouragement as to the object of my search; so, seeing a small farmhouse a little off the beaten track, I went to make inquiries, and also to refresh myself; after which the old man of the farm took me down to the edge of a field and pointed out the valley, and there I photographed my first view of the earth pyramids. Thanking the old man for his kindness, I departed to seek a closer inspection of those curiosities.

I had walked for about a mile when I became aware of a large piece of rock gradually growing out of the valley on my left hand, and a few steps more showed me that I had come upon the giant of the vale; but to photograph it was to be a rather ticklish job. "Faint heart never won a photo of earth pillar," thought I; so down I went into a thicket of grasses, weeds, and thorns, waist-deep, until I obtained a suitable position, and was even then not on very safe footing, as it was of a crumbly nature. However, I managed to take a photograph, and on looking around to see where I would be able to obtain a better view, I noticed that were I to get to the other side I would have a much better view of it; so again I struggled with the weeds and undergrowth, and, after three-quarters of an hour, managed to get to the desired position. Having exposed another plate on it, I rested a while, then pursued my course to procure a view or two of the range of the Rosengarten, and about one o'clock I had reached the termination of my ascent, having attained an altitude of 3795 feet, and having accomplished a climb of 2915 feet. Seeing some very fine clouds gathering over the mountains, I immediately took two snap-shots at them; and as I did not like the general appearance of the sky, I determined to return. Having got down as far as the earth pyramids again, I could not resist taking another photograph, and had just finished packing up my camera when the rain began; and it *did* rain, I can tell you, as it generally does in mountainous districts, so I had a rather wet walk of two hours' duration. But I arrived safely at the hotel, and none the worse; so "all's well that ends well."

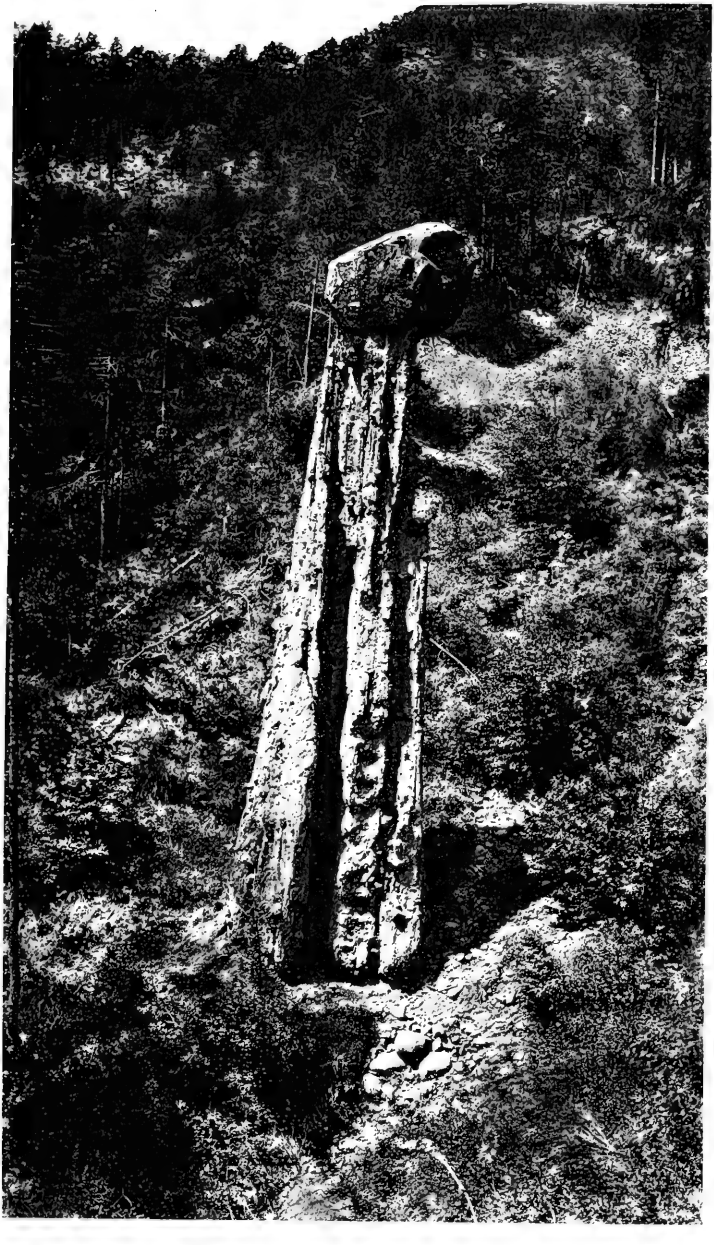
Regarding the formation of these pyramids, Sir Archibald Geikie, in his 'Text-Book of Geology,' says:—

> While the result of rain action is the general lowering of the level of the land, this process necessarily advances very unequally in different places. In numerous localities great varieties in the rate of erosion by rain may be observed. Thus from the pitted channeled ground lying immediately under the drip of the eaves of a house fragments of gravel stand up prominently, because the earth around and above them has been washed away by the falling drops, and because, being hard, they resist the erosive action, and screen the earth below them. On a larger scale the same kind of operation may be noticed in districts of conglomerate, where the larger blocks, serving as a protection to the rocks underneath, come to form, as it were, the capitals of slowly deepening columns of rocks. In certain valleys of the Alps a stony clay is cut by the rain into pillars, each of which is protected by, and indeed owes its existence to, a large block of stone which lay originally in the heart of the mass. These columns are of all heights, according to the positions in which the stones may have originally lain.

Prestwich, in his work on Geology, draws attention to similar formations in the Western Hemisphere. He says:—

> For about three miles along the side of South River in America, and for half a mile in breadth, the wooded slopes are studded with hundreds of these monuments, some of which rise to the height of 400 feet, the average being from 60 to 80 feet. High spruce-trees of great size seem like dwarfs by the side of these mighty columns, each one of which is capped by a projecting boulder of very various sizes. In this case the weathering results from the degradation of a soft conglomerate, composed of a volcanic sand with trachytic boulders of various sizes. The surface waters and rain flowing over the escarpment of the valley are stayed by the blocks, and then, running down on either side of them, remove the soft cementing mass, but leave that which immediately underlies the boulders standing as columns, until after a time the boulder topples over, and the column yields to further pluvial action. Storms assist by beating against their sides and carrying away the smaller particles and sand.

Lastly, Professor Geikie, of Edinburgh University, in a note to me on the subject, sums up the cause of these pyramids in a brief sentence: "They are the work of rain,—they are, in short, the relics of a mass of morainic matter." See also Lyell's 'Principles of Geology,' vol. i., chap. xv.



THE GIANT OF THE VALE.

VII.—*ON THE DISSOCIATION OF A LICHEN.*

By Mr WM. C. CRAWFORD, M.A.

(*Read Feb. 24, 1892.*)

A LICHEN, as is well known, consists of an alga and a fungus living together for mutual advantage. The association of the two organisms is so intimate, that lichens were considered till about twenty-five years ago as simple plants forming by themselves a division of Cryptogams.

The theory of the compound nature of lichens was first published in 1868 by Professor Schwendener, who was led to his theory by anatomical considerations alone. The theory was strongly supported by philosophical botanists, while the lichen collectors opposed it with a virulence remarkable in scientific literature. The problem of the simple or compound nature of lichens may be solved in two ways. The suitable fungus, usually one of the discomycetes or pyrenomycetes, may be grown from spores, and the cells of algæ brought into contact with it, and so a lichen may be manufactured. This is the synthetic method. Or a complete lichen may be separated into its constituent living elements, and an attempt may be made to grow these apart from each other. This is the analytic method. The chief interest of the problem does not lie in its solution merely, but rather in new problems which arise out of it. The synthetic method has been pursued successfully by several distinguished botanists; the analytic method of approaching the problem—the dissociation of lichens—has hardly been attempted at all.

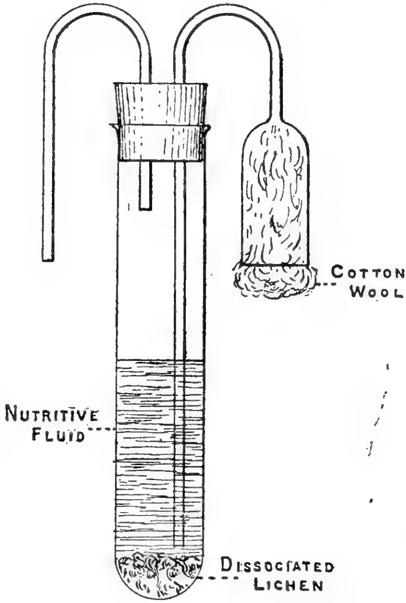
One of the first to try to build up a lichen was the Dutchman Treub ('Botanische Zeitung,' 1873). He planted lichen spores in a drop of distilled water on microscope slides kept in an atmosphere saturated with moisture. A little ash of lichen was added as nutritive material, and after the spore had germinated for a fortnight or so, gonidia were brought into contact with the growing filament. The fungal filaments attached themselves to the gelatinous envelope of the green cells, and then grew on more vigorously than before, showing that some nourishment was obtained from the algal cells. Treub was terribly troubled with mould growing in his cultures, as was naturally to be expected from the method he adopted, and although he made a very great number of cultures, and took a vast amount of trouble, none of his cultures survived more than a few weeks; and upon the whole his opponents, the lichenologists, were right in maintaining that his experiments did not go far to solve the problem.

The next great observer who made an elaborate contribution to the subject was Bornet ('Ann. Sc. Nat. Bot.,' 1873). He lays emphasis on the fact that the relation between green cells and the colourless filaments was hardly known, and it was very important to observe that the green cells did not arise out of the colourless hyphæ. In other words, he showed that there was no genetic relation between the one and the other. Bornet studied sixty genera of lichens, and described the algæ which belonged to them. The kinds of algæ to which the gonidia seemed to belong were far fewer than sixty, one species of alga serving as the guest of a number of lichens. Although Bornet's paper is admirable in the highest degree, it throws hardly more light than Treub's did on the real solution of the problem.

The last contribution to this phase of the question which I shall mention is one by Bonnier ('Ann. Sc. Nat. Bot.,' 1889). The author used Pasteur flasks and pieces of hard rock sterilised at 115° C., and maintained that he succeeded in producing lichens from lichen spores and real algæ,—not from gonidia, as the other investigators had done. He used Protococcus and other unicellular algæ.

Now we turn to the other aspect of the question—the dissociation of lichens. Two excellent observers, Faminzin and Baranietsky ('Botanische Zeitung,' 1887), took thin sections of lichens, as well as pieces of the thallus, and cultivated them for some weeks on fir bark in a moist atmosphere, allowing water to drop upon the bark from a siphon. The structure of the lichen was softened, and here and there completely destroyed. The gonidia, however, remained quite sound, and after two or three months zoospores were observed. No remark is made in the account the authors give of their experiments as to sterilising the water which dropped from the siphon; and as spores of algæ are very common in the purest of natural water, one feels some doubt as to the results of the experiments. Curiously enough, these observers advocate a theory the contrary of Schwendener's: they believe that unicellular algæ are freely vegetating lichen cells.

Quite recently an Italian botanist ('Nuov. Gior. Bot. Ital.,' 1890) noticed the natural dissociation of a lichen (Lecanora) growing on an old wall. There were, he says, patches of a deep green colour caused by masses of an alga (Protococcus). He attributes the dissocation to excessive humidity, which hindered the fungus from putting out its short filaments to lay hold of the gonidia.



Now I come to my own experiments. Two years ago I took some test-tubes and arranged small tubes to pass into them, as is shown in the accompanying figure.

Into the expanded part of one of the small tubes sterilised cotton-wool was pushed; that tube passed down to the bottom of the test-tube: another small tube passed just underneath the cork inside, and outside was bent over to be parallel with the test-tube. These were somewhat longer than is represented in the figure. The test-tubes were half filled with water, having a little of Sachs' nutritive fluid added to it, and this was repeatedly boiled to destroy spores, &c. The water was aerated by attaching the tube not containing the cotton wool to an aspirator, air being pulled through it for several minutes. Small pieces of lichen (Physcia parietina), after being carefully washed in boiled water, were placed in the sterilised test-tubes. The corks were reinserted, and the tubes were suspended on the back wall of a very sunny greenhouse, where they remained from April 1890 till now (February 1892). The water remained perfectly fresh, the fungal part of the lichen became colourless and died, while the algal part got greener and grew considerably. The sterilisation was, I believe, complete: all larger spores were removed by the washing in the boiled water, while any bacteria which might be carried into the fluid on the lichen were probably killed by the constant exposure to the bright direct sunlight.

One of the most striking things to be noticed is the way the lichen-alga withstands the direct rays of the sun. When algæ are cultivated artificially we know how essential it is to shade them from the direct sunlight, or else they die in a few days: the sides of the beakers in which they are grown are usually covered half-way up with brown paper to make the culture successful. A most distinguished chemist, who has analysed different kinds of chlorophyll, says he has never been able to analyse correctly the chlorophyll of cryptogams, on account of its becoming so readily decomposed by light. Here these little algal cells grew and prospered for a couple of years, exposed to as intense a light as this climate affords.

I have set up another dozen or more tubes, and I hope at some future time to report to the Society the results.

VIII.—*ON SOME SIMPLE MEANS OF ASCERTAINING THE FOCAL LENGTH OF COMPOUND SYSTEMS OF LENSES.*

By Mr Wm. FORGAN, F.R.M.S.

(*Read Feb. 24, 1892.*)

Mr Forgan first referred to the simple method of finding the focus of a single lens, as described by the late Rev. T. W. Webb in the first edition of his 'Celestial Objects for Common

Telescopes.' He then pointed out the method of measuring these, and of ascertaining the focal length of compound systems, such as a microsocope eyepiece, by means of an empirical formula devised by Mr Charles Cross, and fully described by Colonel Dr Woodward in his paper "On the Nomenclature of Achromatic Objectives," in the 'American Science Review' for 1872. The formula was—

$$\frac{m \times l}{(m+1)^2}$$

—where l is the distance between the scale to be magnified and the screen upon which its image is projected by the lens, and m the magnifying power at that distance.

At this meeting Mr Robert Stewart, S.S.C., read a paper entitled "Ancient Natural History Beliefs." The paper treated of the scientific notions of some eminent naturalists of a bygone time, and was of a very racy and interesting character.

IX.—*AN ERROR OF INSTINCT.*

By Mr SOMMERVILLE GRIEVE.

(*Read March 23, 1892.*)

We have so many wonderful manifestations around us of the unerring instinct of the animal creation, that we are apt to give way to astonishment when it apparently fails. Instinct is seldom wrong, when guided by its own promptings amid natural phenomena; but when brought in contact with the inventions and contrivances of man, it not unfrequently breaks down. The lighthouses along our coasts are periodically besieged by birds at night, many of them being killed in striking the lamps during the spring and autumn migration. Innumerable instances might be forthcoming to prove the disturbing influence of man upon instinct. My special object this evening in bringing this subject before the Society is to relate a case of the failure of instinct which came under my observation during a visit to Machrihanish last autumn. When walking northwards from the golf-course, over a country made up of sand-dunes covered with reeds and long grass, my attention was attracted by the strange position of a large bird. It was a solan goose. There it lay, with its beak imbedded a couple of inches in the ground. A careful examination revealed no external wounds, with the exception of those incidental to a severe concussion. The upper and under mandibles were bulged in, the posterior parts indicating that the shock was sustained on the bill of the bird. Most of us are conversant with the flight of the gannet, and with the suddenness with which it precipitates itself into the water. A fall such as this could only have caused the terrible injuries. Probably the gannet had observed some prey and mistaken the undulating sand-dunes for the waves of the sea, with such fatal consequences to itself.

The day I was along the shore was wild and stormy. It was dry, but the wind was blowing a gale. The spindrift was circling over the waters, and the great big blue waves were churning their surges into a dirty spoom. The tidal line was covered with this foam, which the wind lifted and carried about. The sandpipers were running along the shore, and had difficulty in freeing themselves from the froth. One was found so enveloped that it was quite helpless, and would probably have been drowned had it not been rescued. I saw many of the birds in this difficulty, but, strange to say, they would persist in keeping close to the water-line, notwithstanding their danger. During the gale the sand was lifted in clouds and blown inland. I noticed the wind producing on the shore sand that wavy appearance suggestive of the action of water. The surface being damp, the dry sand impinging upon it took this form. Professor Green, speaking of blown sand, says: "These sandy accumulations often show, when cut into, rude bedding, and the action of the wind produces in them structures exactly analogous to the current bedding and ripple drift of subaqueous sandstones."

At this meeting Mr John Lindsay read a paper entitled "A Scientific Garden: Being a Descriptive Sketch of the

Garden at Easter Duddingston Lodge." This paper has now been privately printed, illustrated by portraits, and by views in the well-known garden of the late Mr Charles Jenner, from photographs by Mr Swan Watson, Edinburgh. A copy of the paper has been presented to each member of the Society, in remembrance of Mr Jenner, who was one of the oldest members of the Society, and of Mr Gorrie, one of its early Presidents, and who planned and laid out the garden at Easter Duddingston.

X.—*AN OBSERVATION ON MIND IN MOLLUSCS.*

By Mr WM. C. CRAWFORD, M.A.

(*Read April 27, 1892.*)

One evening last summer I had some fish heads boiled to make a clear soup. The soup was made in order to putrefy, and so give rise to new forms of life—for "putrefaction arises from life, not from death." I wanted to observe the different races of bacteria and monads which appear in succession during the course of many months in putrefying decoctions, and I used fish soup as a very suitable substance to employ for that purpose.

When my bowl of soup was still steaming, I placed it outside in the garden to cool. It may have remained there half an hour or more, when I was surprised to notice that a brown slug had climbed up the outside of the bowl and down the inside, and was imbibing the juice copiously; at the same time a shell-bearing snail was making its way up outside the bowl. Very soon this second mollusc had got down to the fish juice and partook of it, apparently with great zest. I now noticed a similar snail, about two feet away, coming down a wall and directing its course straight to the bowl. In a quarter of an hour or so this third mollusc had reached the attractive juice. By this time the first slug had so gorged itself that, after breaking out into a copious perspiration, it fell into the soup altogether. I took it out and placed it upon a stone, where it remained the whole evening motionless; by the morning it had probably recovered from its excess, for it had disappeared.

I now saw a large black snail 8 or 10 feet away, crawling slowly up a walk in the direction of the bowl. As twilight was approaching I did not feel inclined to wait and see the result, and to save the snail the trouble of travelling so long a journey I removed the bowl to a place about a foot away from it, placing it at a right angle to the snail's path, so that it would have been naturally passed by. The snail stopped and remained in the same place for at least twenty minutes. The evening was quite still, so that the wind did not blow smells in one direction more than another. This was the period of deliberation, to use a human expression. The snail was taking its bearings. "There is a delightful odour about—where can it be?" In another half hour this, the fourth, mollusc had found the nectar.

I presume that what may be called mental operations proceed very slowly in animals much lower than man, and this long period of deliberation, as I have called it, reminds me of a similar phenomenon I have observed in frogs. I have sometimes kept frogs in a greenhouse and fed them with worms. On giving a frog a worm on a stick, at times when it must have been very hungry, I have seen it stare at the worm for two or three minutes. The mental operation the frog was performing, translated into a human form of thought, was most likely this—"That looks like a worm, but what a queer place for a worm to be, wriggling on the end of a stick." Finally froggy makes up his mind that it must be a real worm, his tongue darts out like lightning, and the end of the worm is down his throat in an incredibly short time.

Later in the evening, I found that other two slugs had found their way into the bowl—six in all had been attracted to it in a couple of hours.

There are so few observations on record of the intelligence of the mollusca, I have thought it worth while to lay these before you. They show a considerable amount of intelligence. The essential purpose (I suppose I must ask pardon for using the word *purpose* in speaking of physiological things, but I do not know a better word)—the primary purpose of a sense organ is to enable the organism to respond to external influences. Here in the mollusca we have mental powers far above simple sensation and reaction.

There is a curious story given in Darwin's 'Descent of Man' of a pair of snails, and from it Mr Darwin says: "These animals appear susceptible of some degree of permanent attachment: an accurate observer, Mr Lonsdale, informs me that he placed a pair of land snails (*Helix pomatia*), one of which was weakly, into a small and ill-provided garden. After a short time the strong and healthy individual disappeared, and was traced by its track of slime over a wall into an adjoining well-stocked garden. Mr Lonsdale concluded that it had deserted its sickly mate, but after an absence of twenty-four hours it returned, and apparently communicated the result of its successful exploration, for both then started along the same track and disappeared over the wall."—(P. 263.)

Notwithstanding the ponderous authority of the author of the 'Origin of Species,' who seems inclined to accept so very human and socially highly developed explanation for the very simple observations, I would suggest another much less anthropomorphic. The strong snail smelt something nice on the other side of the wall; he went over and partook of it. That done, he went back to his usual quarters, according to habit. The poor snail left at home smelt an odour of good food about her companion, and next time following the scent, went with him.

In speaking of the mental operations of animals very different from man in bodily organisation, we should be extremely careful not to fall into what has been called "inverted anthropomorphism," and to use of animal intelligence expressions which apply properly only to our own intellect, and feelings, and will. There is probably a psychological continuity running through organic nature, just as there is a morphological continuity.

> "Nothing in the world is single;
> All things, by a law divine, in one another's being mingle."

Some of us may think, with Clifford, that every moving molecule, every vortex ring, it may be, possesses a small piece of *mind-stuff*—that every cell has a mind, however elementary—that as organisms are built up into many types, so consciousness has many forms. But I am treading on speculative if not on dangerous ground.

Will there ever be a science of comparative psychology? This century has seen the birth and growth of comparative anatomy, comparative philology, comparative religion. Fraunhofer and Kirchhoff and Bunsen and Huggins have shown that the material universe is composed of the same material elements: will thoughtful men of the future show that some similar unity pervades what, for the want of a better expression, we may call "mind-stuff"? I believe they will,—

> "And men, thro' novel spheres of thought
> Still moving after truth long sought,
> Will learn new things when we are not."

At this meeting Mr Hugh Fraser read a paper on "Some Interesting New Zealand Plants," and exhibited specimens of several of these, chiefly Veronicas.

EXHIBITS IN NATURAL HISTORY.

DURING the Session a number of interesting objects connected with Natural History were exhibited by members of the Society, as follows:—

BY MRS SPRAGUE.

Egg of Bulimus ovatus.—This egg appears at first sight to be a bird's egg, and it is rather startling to be told, and hard to believe, that it is the egg of a mollusc. On examination, however, the egg is found to be of a different texture from a bird's, and is evidently more brittle. The animal—a gasteropod mollusc—attains a length of six inches, and is sold in the market at Rio. The young, when hatched, are an inch long.

The "Bulrush Caterpillar" of New Zealand.—The native name of this is "Aweto," and the following account of it is taken from a book entitled 'Kaipara,' by P. W. Barlow (Sampson Low & Co., 1888): "This caterpillar becomes changed into a white vegetable substance while still retaining its caterpillar shape. It is from 3 to $3\frac{1}{2}$ inches in length, and when about to assume the chrysalis form, buries itself in the ground; and it is supposed that in doing so, some of the minute seeds of a fungus become inserted between the scales of its neck. These the insect, being in a sickly condition, is unable to rid itself of; and they vegetate, and spread through the whole of the body, completely filling and changing it entirely into a vegetable substance, though retaining exactly the caterpillar form, even to the legs, head, mandibles, and claws. . . . In every instance the caterpillar is found perfect in shape and size, without any sign of contraction or decomposition; and it is therefore presumed that the vegetating process takes place during the insect's life."

Vertebra of Razor-back Whale.—The vertebra exhibited was dug out of the White Sands, near Aberdour; and was one of fifteen vertebras discovered by some workmen while driving piles in connection with drainage operations. Professor Struthers states that the vertebra is that of a Razor-back Whale, so called from the great lateral compression of the hinder part of the trunk (caudal region) behind the dorsal fin—this being so compressed that it suggests a two-edged knife. Its scientific name is *Balænoptera musculus;* the specific name being given to it in consequence of its great activity compared with other large whales. It may attain a length of from 60 to 70 feet, with a pectoral fin of nearly 8 feet. It is clear that the animal to which this vertebra belonged was stranded on the sea-shore, in the same way as whales have every now and then been stranded in our neighbourhood in recent years. The vertebra is comparatively recent, and not fossilised, as has been stated in the newspapers.

Opalescent Lenses from the Eye of a Cuttlefish.—The base of each lens is nearly flat; and there are two lenses of unequal size in each eye, their plane surfaces facing each other, with a thin membrane between. Lenses such as those exhibited are found, along with arrow-heads, &c., in the tombs of the ancient Peruvians. They are sometimes made into solitaires by jewellers, but they would probably not stand rough usage.

Mummied Cats.—The following account of the arrival in this country of a "cargo of cats" appeared in the 'Scotsman' of February 4, 1890: "There has just arrived from Alexandria at Liverpool, by the steamers Pharos and Thebes, a consignment of nearly 20 tons of cats, numbering 180,000 head, taken out of an ancient subterranean cats' cemetery, discovered about 100 miles from Cairo, by an Egyptian fellah, who accidentally fell into the cemetery. The place was found to be completely filled with cats, every one of which had been separately embalmed and dressed in cloth. They were all separately laid out. Specimens of these have been taken by Mr Moore, curator of the Liverpool museum, where they can be seen. The cargo, consigned to Messrs Levington & Co. of Liverpool, was purchased in Egypt at £3, 13s. 9d. per ton, and will be used in this country as manure. The curator of the Liverpool museum fixes the date of the interment of the cats at 2000 before Christ."

Mrs Sprague, having read this account, wrote to Messrs Levington & Co. for specimens of the mummies, and received a printed circular stating that they had had such a mass of correspondence on the subject, as to bring their regular business to a standstill; and offering to sell specimens of the heads at 2s. 6d. each. Three were purchased, and Messrs Levington sent along with them the body of a cat and a fragment of the cloth in which it had been wrapt. These were exhibited to the members of the Society.

By Mr A. B. Steele.

The Beef-steak Fungus (*Fistulina hepatica*, Fr.).—This specimen was from Mr William Evans, who got it growing on the decayed trunk of an oak tree in the Palace Gardens at Dalkeith. Although common in England, it is not so in Scotland, and its usual habitat in this country is the oak tree. On the Continent, however, it is most commonly found on the chestnut, and is called "the tongue of the chestnut." It was lately found growing on a chestnut tree in a garden on the south side of Edinburgh by Dr William Craig, which is the only instance on record of its growing on that tree in Scotland.[1]

The Fork-tailed Petrel (*Cymochorea leucorrhoa*, Vieillot).—This specimen was shot last September by Mr Campbell Mackechnie on the shore of Loch Frisa, in the island of Mull. It was weak on the wing, and probably the protracted stormy weather previously had driven it ashore in a feeble condition. They never come to land except in the breeding-season in June. In the latter part of September and the beginning of October the weather was very stormy, and unusual numbers of the fork-tailed petrel are recorded to have been seen in Ireland and the west of Britain—driven ashore, no doubt, by the high gales. It breeds in Britain only in St Kilda and in one or two islands of the Outer Hebrides.

Eggs of the Great Skua.—Several eggs of the Great Skua (*Stercorarius catarrhactes*, Linn.) were exhibited; and there was read a report, by Mr W. Eagle Clarke, F.L.S., on these birds, for the season of 1891. This report is now printed in the 'Annals of Scottish Natural History' for 1892, pp. 87-92.

Polyporus igniarius, F.—The specimen exhibited was an unusually large one, and was found growing on an ash-tree in Dalmeny woods, near Edinburgh.

By Mr A. Moffat.

Fasciation in Narcissus.—This was a very rare and curious example of fasciation in the flower of Narcissus poeticus.

By Mr Wm. Forgan, F.R.M.S.

A New Semi-apochromatic Microscope Objective.—The lens shown was a No. 3 by Leitz of Wetzlar. It has, like all the Continental objectives of that number, a focal length of two-thirds of an inch. The term semi-

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[1] See article by Dr Watson, "The Sacred Plant of the Druids," *ante*, p. 20, for further information regarding the Beef-steak Fungus.

apochromatic was devised, it is believed, by Mr E. Nelson to designate those lenses which are made of the new descriptions of Jena glass manufactured by Messrs Schott & Co. They differ from the apochromatics in having no fluorite lenses in their composition. Dr Czapski has stated that the term used is one not quite applicable, as there certainly is nothing peculiar in their construction further than the use of the new glass. The particular objective exhibited gave very fine sharp definition in the centre of the field, but it had a considerable amount of spherical aberration.

Fasciation in a Pine.—This specimen of fasciation formed the top of an Austrian pine which grew in the grounds in front of Mr Forgan's house, Woodend, on the western shore of the Gareloch. The fasciated portion was from four to five inches in breadth and over a foot in length. The tree was a young one, about ten feet high, and when cut down in September the fasciated portion was the growth of the previous season. It showed a very decided twist, the spiral following the direction of the movement of the sun. Mr Hugh Fraser, Leith Walk Nurseries, made a few remarks on the exhibit, and said it was perhaps as fine a specimen as he had ever seen.

By Mr George Bird.

The Chough.—Mr Bird exhibited a specimen of the Cornish Chough or Red-legged Crow (*Fregilus graculus*), and read an interesting communication on the habits of this somewhat rare denizen of our British sea-coasts. The specimen shown was shot near Colonsay.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Society was held at 5 St Andrew Square on the evening of October 26, 1892,—Dr T. B. Sprague, President, in the Chair. The Secretary intimated that 6 indoor meetings had been held during the Session; and that there had been 6 field excursions, to the following places: Hawthornden to Polton (May 14), Ratho and Kirkliston (June 4), Culross (June 25), Greenend to Little France and Kingston Grange (July 2), and Gosford Links (July 9). On July 16 the members of the Society were invited to a garden-party at Easter Duddingston Lodge by Mr Charles Jenner, where luncheon and tea were served in the grounds, and a most enjoyable day was spent. A photograph of the party was taken before dispersing.

During the Session 25 new members were added to the roll, making a total of 161. The income was reported by the Treasurer to be £60, 10s., and the expenditure £58, 5s. 6½d.; but an unpaid balance of £10, 13s. on the printing account, brought out a net deficiency of £8, 7s. 6½d.

The Office-bearers elected to fill up vacancies were the following: Dr T. B. Sprague, re-elected President; Mr A. Moffat, re-elected Secretary and Treasurer; Mr J. Lindsay, re-elected Editor and Librarian; Mr William Coats, elected Vice-President; with the following new Members of Council: Messrs Sydney Keith, James Fraser, R. C. Millar, C.A., A. B. Steele, and Tom Speedy. The Auditors appointed were Messrs H. H. Pillans and John Pairman, S.S.C.

SESSION 1892-93.

I.—*A DAY WITH THE DUMFRIESSHIRE OTTER-HOUNDS.*

With a few Remarks on the Otter.

By Mr J. T. MACK.

(Read Nov. 25, 1892.)

By many, including not a few sportsmen, the otter is a much misunderstood and a greatly maligned animal. Old Izaak Walton, for example, in his 'Complete Angler,' wrote of otters as "base or villanous vermin," because of the quantity of fish which they destroyed. He even recommended that keepers of otter-hounds should receive bounties from the Crown, to encourage them to exterminate otters altogether, owing to the evil reputation they possessed as destroyers of fish. Indeed this common belief regarding their relentless warfare upon valuable fish has wellnigh led to their total extermination. At one time otters were to be met with in almost every loch and river in the country, but, in consequence of their evil reputation, and of the value of their fur, as well as their provocativeness as beasts of chase, they have been generally killed down. Only in the northern counties of England and the southern districts of Scotland are they now found in anything like large numbers.

Around the coasts of Scotland, notably in the Orkney and Shetland islands, otters are met with occasionally of a larger size than those seen on our rivers. They frequent the holes and crevices in the rocks, and are shot or trapped for the sake of their fur. The otter which haunts our rivers, however, is the best known. Belonging to the weasel group of carnivora, it resembles greatly a huge overgrown weasel. A full-grown male otter weighs from 18 to about 26 lb., though a friend of mine once killed one of 29 lb. The head and nose are broad and flat; the eyes are small and brilliant, and so placed as to enable the animal to discern objects above it as well as in other directions. The ears are short, and the mouth is small, with muscular lips. The legs are very short, the feet slightly webbed. The fur, which is valuable, is generally of a brownish-grey colour. When killed in winter, otters' skin is used for making gloves, vests, &c., as it is not only very durable, but retains its softness and pliancy after being repeatedly wetted.

I have said that the otter is both misunderstood and maligned, and I say so chiefly because of its being, I consider, unjustly blamed for destroying large quantities of valuable fish. Indeed I saw it stated not long ago that one otter destroyed a ton of salmon in the course of a year. This is simply nonsense. In the first place, an otter cannot capture a clean-run salmon in open water, as it is much too fleet for it. It may occasionally secure one by stratagem in shallow water, but clean-run salmon are, as a rule, perfectly safe from the otter. Any fish of the salmon kind which it manages to catch are mostly diseased, sickly fish, which are better out of the way than disseminating disease; and in killing them, the otter is only fulfilling a beneficent law of nature. One of the best known authorities on natural history in Scotland told me, not long ago, that he once traced two otters for a considerable distance along the banks of a river, partly through finding the remains of fish they had killed, and these fish were all sickly specimens. My friend eventually shot both the animals he was hunting.

When the otter does catch a fish of the salmon kind, he seldom eats the whole fish. The *bonne bouche* appears to be the part between the neck and dorsal fin. In fact, he appears to be a bit of an epicure in the matter of fish. Any one having doubts as to what the otter usually feeds on, however, can set these doubts at rest by examining its excrements. These will be found to consist almost invariably of the flesh and small bones of eels, and nothing else. A gentleman with whom I am acquainted kept a tame otter for some months, and fed it principally on small burn trout, eels, haddocks, roach, and sheep's liver; but the animal much preferred eel to all other fish, and when eels were placed in its tank it invariably dived after them, caught them by the neck, and leisurely devoured them. A year or two ago, while the Dumfriesshire otter-hounds were hunting Lochmaben loch, they disturbed and afterwards killed an otter in the act of devouring an eel 4 lb. in weight; and they found another eel about the same weight in Craigilands fish-pond, Moffat, newly killed by an otter. In fact, while this pack of hounds were hunting one of the Dumfriesshire rivers one day last year, and while in full cry after an otter, the animal left the water with an eel in its mouth, in full view of the hunt. Now if anglers would only consider for a little, instead of calling for the destruction of the otter as their enemy, and were they to study him more, they would find that he is in reality one of their best friends, for not only does he kill off sickly, diseased fish, but in living so much upon eels he destroys fish which devour large quantities of salmon and trout ova and fry. I once caught an eel having a large burn trout half-way over its throat, and one eel can account for a considerable number of fish. The otter, then, in carrying on warfare amongst eels, is conferring a benefit upon anglers, and assisting to preserve the balance of nature.

In its habits the otter is nocturnal, and it seldom appears during the day unless when disturbed. When disturbed and pursued for any length of time, it leaves the locality where it has been hunted, and travels a great distance. During the night, when in search of food, or calling to its mate, it utters a short, sharp, whistling sound. When engaged in night fishing, I have come upon the otter ranging along the bank of the stream as if hunting for some prey other than fish, and I have known them pay a visit to some rabbit-hutch or hencoop a considerable distance from their usual riverside haunts. It is not quite correct to call the otter an amphibious animal. In reality it does not live in the water at all, but only enters it for the purpose of taking fish. It burrows on the banks of a loch or river, generally under some overhanging tree or clump of bushes. The burrow is a curious arrangement. The entrance is from under the water, working upwards to the surface of the ground, forming several ledges to which the animal may retreat in the event of floods; while air is admitted through an orifice in the roof or side, amid the cover of some bush or other concealment. The entrance being from the water, it serves very well for purposes of escape from its enemies, as whenever an attack is made on its stronghold it can slip into the water unobserved, and may be away up or down stream unknown to its pursuers, unless a good watch is set upon the water in both directions.

Otter-hunting is comparatively unknown in Scotland, with the exception of the southern counties, where one of the finest packs of otter-hounds in the kingdom, the Dumfriesshire, furnishes excellent sport. The following may be taken as a fair description of the sport they afford.

Up we got early in a June morning, when all bird and animal life is astir and farm-labourers have begun their day's darg. After a good breakfast of "halesome parritch" and cream and other country cheer, we sally forth clad in strong garments, heavy boots, and a good thick staff. The hounds meet at Dinwoodie, within easy distance by rail, at 8.30. Punctual to the hour are the hounds, huntsmen, and sportsmen. The sun is shining brightly, and no time is lost in detraining the dogs and leading them down to the Annan. Kerss, the keeper, who knows every foot of the river, and is come of a well-known stock of Border sportsmen, assures us that the "varmint" is not far off, for he was heard "whustlin" down below the brig the other night. Along the banks of the Annan, therefore, race the hounds and terriers, plunging into the pools, swimming and re-swimming the river as each tree root and likely spot is examined. Occasionally a hound makes the welkin ring with his deep musical baying, but nothing important comes of it. On we tramp by the riverside, as each likely spot is tried and found blank. After two or three hounds leave the water and begin to sniff about on a level part of the riverside they give tongue, splash go huntsmen and hounds out of the water, up go the dogs' noses, and the whole hunt makes off up the riverside for some distance till they suddenly come to a standstill. It is no go. His ottership has been out for a morning stroll, and has then taken a bath, and evidently remained in it, as no further trace of him is found. Another hour is pleasantly spent in trying both banks of the river for a mile or two farther up, but nothing is done in the way of getting a "start." After retracing our steps "doon the water," we come upon a mill-lade, along which the water races swiftly. Dewdrop, one of the best of the pack, stops at an overhanging tree-root, and begins to scrape. "Keep your eye on Dewdrop," cries one of the hunt; "he makes no mistakes." Suddenly another member of the hunt, who has been on the watch farther down, makes the woods echo with his view-halloa. His ottership, annoyed at Dewdrop's attentions at his citadel, had slipped out into the water unobserved, and, after swimming beneath the surface for some distance, had put up his head to "vent" or breathe, and so had got "spotted." Instantly the whole pack—huntsmen and spectators—are on his track. Compelled to leave the mill-lade, he plunges into the river, and now comes the exciting time. The otter tries to evade his pursuers by disappearing beneath the surface of the water and doubling back, but in vain. Hunters standing on the bank mark his dodge, and head him up, as the object is to drive him to an open spot and force him to leave the water at a shallow place. Again and again he tries, by doubling back or sneaking unobserved behind tree-roots or drain openings, to elude his pursuers, but all is useless, as the hunt spread themselves out along the banks and keep a watchful eye on the bottom of the river. Matters are now very exciting. There is an echo in the glen, and, as the deep rich baying of the dogs is mingled with the notes of the huntsman's horn and the view-halloas of the sportsmen, the sounds given back by the echo are very stirring. Whenever a hound "spots" his game he plunges over the head after him, but the otter is too 'cute. Suddenly we are taken round the bend of the river to a spot where broken trees and brushwood have been heaped up and fastened in to prevent the river from washing away its banks. The otter is evidently making for here as a haven of rest, and here he eventually reaches. After fighting unsuccessfully to drive him from his stronghold, a hole is made in the thicket, and the plucky little terriers are introduced. In they go out of sight, scraping, barking, and struggling, as they know the otter is there. The sportsmen enter the water, and, standing up to the knees, encircle the pool to prevent the otter escaping. After an hour's digging and scraping we are compelled to admit that the otter has beaten us, and we leave him to chuckle over his well-won victory.

But the sky is now changed. Dense masses of lurid clouds are gathering around us, which give sufficient indications of the coming storm. Darker and darker it grows, thicker and thicker becomes the gloom, denser and denser the atmosphere, as the storm draws nigh. We hastily seek shelter in an empty mill on the water-side. Huntsmen and dogs hurry-scurry out of the river into the barn, and not a minute too soon. Crack! crack! crack! with the sharp ringing distinctness of a rifle, joined to the deafening roar of the heaviest ordnance, as the thunder rolls far away across Annandale. The flashes of lightning are as incessant as the peals of thunder, while the floodgates of heaven seem to have burst asunder, and torrents of water are discharged over our heads. But the storm leaves as suddenly as it comes, and the sun shines out once more, warmly and brightly. After flasks and sandwiches are handed round, the master of the hunt says, "Come, let us kill an otter." Off we go, some two miles across country, to Jardine Hall water, where, after a little trying, we start the "varmint," who takes over some fields, and finally eludes us in a private pond. It is now near train time, and the hounds are reluctantly drawn off and taken away to the railway station, after having provided a most delightful day's sport, although it did not end in a "kill."

Our ancestors divided the beasts they pursued into three classes. The hare, the hart, the wolf, and the wild boar were "beasts of hunting"; the fox, the buck, the doe, the marten, and the roe were "beasts of chase"; and the third class comprised the badger, the wild cat, and the otter. This is placing our otter in rather commonplace company, and I do think he deserves to be ranked in better society. I have taken part in nearly every one of our Scottish field-sports, and I do not hesitate to say that a really good otter-hunt is one of the most interesting and exciting in existence. The dogs employed in the sport are large, wiry-haired animals, strong swimmers and divers, and capable of great fatigue. Large sums are paid for them: a good pure-bred otter-hound cannot be purchased for much under £25, and French sportsmen think nothing of paying double that sum for them.

One of the finest sights to be seen in the hunting-field is the working of a good pack of otter-hounds. It is perfectly marvellous how the dogs "feather" the line of an otter, in and out of the water, often four or five hours after it has been known to pass the ground hunted over. This is all the more wonderful, because the human nose cannot detect any smell either in the otter or in its excrements. Yet I have seen them again and again take up the line either through brushwood, over stones and gravel, or far into a field of corn. The baying of the hounds is very deep and musical, and it is extremely fascinating to a sportsman's ear to hear the pack in full cry, accompanied by the cheery notes of the huntsman's horn. When the otter has been bolted and hemmed in within the bounds of a large and deep pool, the excitement is intense, as the dogs swim and re-swim the river, diving after the "varmint" as he rises to the surface for a second or two to "vent" or breathe, only to disappear from view altogether, diving, and showing himself next time probably near the side of the pool. When swimming up the bottom of the river in clear water, the otter presents certainly a strange appearance. He resembles an animated log of wood, of from three to four feet long, forcing its way through the water.

Like the fox, the otter dies mute, but he offers much greater resistance than reynard. I have known three fox-terriers and a hound or two tackle him all at once and he beat them off. His powers of fighting in the water are very great. So long as he can keep to that element his methods of self-defence are difficult to overcome, and I have known him keep an entire pack of twenty hounds and four or five terriers busy for upwards of three hours, and yet remain in the water, more or less, and on the move.

Otter-hunting possesses one great charm—viz., it is engaged in during the most attractive portion of the year, from May till September, when Dame Nature is clad in her showiest garments, and when the true student of natural history finds much to feast his eyes upon. The river is teeming with aquatic life; the foliage around is luxuriant, and swarms with birds of various descriptions; and as for the botanist, he may fairly revel in his surroundings. The sport, to the ordinary Nimrod, is inexpensive: an everyday suit of clothes, a pair of strong walking-boots, a good stout staff, and some of the creature comforts in the pocket, are all that is required. The pace seldom exceeds a good walk; and as there are generally numbers of ladies present who require assistance over the fences, ditches, &c., there are plenty of opportunities for displaying one's gallantry. The pursuit inculcates early rising, as the meets take place at hours ranging from 6 to 8.30 A.M., or even earlier, the sport terminating about 2 or 3 P.M. The conventional dress worn by members of the otter-hunt is a dark-blue suit of knickers, with red vest and blue cap. It is quite a common thing, when an otter has been bolted and is giving some trouble by trying to escape either up or down stream, to see the gentlemen of the hunt rushing into the water over knee-deep, trying to hem the "varmint" in. The sport, therefore, is not so tame as it at first looks. As a health-giving pursuit during the summer months, nothing can equal otter-hunting.

II.—*PROTECTION TO BIRDS.*

By Dr WM. WATSON.

(Read Nov. 25, 1892.)

I APPEAR before you to-night to urge you all, and more especially to urge the ladies belonging to this Society, to join the Society for the Protection of Birds, of which the Duchess of Portland is President. Tens of thousands of birds are destroyed annually in order to adorn ladies' bonnets. In India the Commissioner of Scinde says that 3000 black partridges have lately been killed within a few days. A dealer in London lately got an order for 32,000 dead humming-birds. In Europe the same slaughter goes on. The swallow is the friend of man. But for it, hosts of flies and midges would in summer make life hardly endurable in the country. Yet swallows are destroyed in myriads in France by means of electricity. Wires are put up, on which they alight to rest, after their long flight across the sea from Africa, and while they are resting electric currents are sent along the wires. The wagtails living on snails are the saviours of our sheep, which, but for these birds, might be altogether destroyed by liver-fluke. Yet wagtails are destroyed for the sake of a whim of fashion. In America the red-headed woodpecker has been almost entirely extirpated: the result has been, that whole forests have been destroyed by a small bug, on which the red-headed woodpecker fed.

Many more illustrations might be given, but really all I want to do is to urge ladies to be merciful, and adorn their hats and bonnets with flowers and ferns, not with murdered animals, and especially not with murdered birds. Every lady who never wears a bird or a bird's feather in her bonnet is a practical member of the Society for the Protection of Birds; but ladies who desire cards of membership have to pay for them the sum of twopence. The Hon. Secretary is Miss H. Poland, 29 Warwick Road, Maida Hill, London; the local secretary, Mrs Murray, 17 Cumin Place, Edinburgh.

III.—*FIBRE BALLS.*

By T. B. SPRAGUE, M.A., LL.D., &c., President.

(*Read Dec. 23, 1892.*)

The President exhibited specimens of five kinds of fibre balls:—

1. *Algoid balls from Loch Kildonan, South Uist.*—These are of a dark-green colour, and of various sizes, most of them being

from 2 to 6 inches in diameter. They are principally composed of the filaments of a fresh-water alga, Cladophora Ægagropila. The lake is about the mean level of the sea, and it is stated that there are currents in it, flowing outwards and inwards alternately, according to the state of the tide; and these balls appear to be formed by the consequent gentle rolling at the bottom of the water. Probably, as the alga decays, the filaments become slightly glutinous, and thus adhere together. A good deal of mud and sand seems to be often included in the balls, and sometimes two distinct balls form a nucleus for a much larger one. The structure of the alga is seen very distinctly under the microscope, when the balls have been sufficiently softened by maceration. Usually each ball has a series of felty coats about one-eighth of an inch thick. As the balls dry, they shrink; and when they are completely dry, they are very much smaller than when they are first formed.[1]

2. *Balls of pine and larch needles.*—These are found in Loch Tay, usually from the 14th to the 16th of November, after stormy weather. The President paid a visit to Loch Tay in November 1892, for the purpose of obtaining specimens, and found a large number in a small shallow bay about two miles from Kenmore. The balls are very nearly of the same specific gravity as the water, but a little lighter; so that when a large ball is thrown into the water, a very few fibres appear above the surface. The balls while moist are very firm, and are usually quite round, but are occasionally ovate. But when the needles are dry, they shrink very much, and the balls must be artificially confined to prevent their falling asunder. The one in the Museum of the Edinburgh Botanic Garden is held together by thin glue that has been poured over it; but a better plan is to confine the ball in a fine net, such as is used by ladies for their hair. These balls, like the Kildonan balls, seem to be formed by a rolling motion. The waves raised by the wind carry the pine needles forward on the top of the water, and then drag them back along the bottom of the shallow bay. The balls are found on the shore, embedded in a bank of decaying leaves and other vegetable refuse thrown up by the waves; and they generally consist simply of the

[1] See also "The Green Balls of Loch Kildonan," in 'Trans. Field Nat. and Micro. Soc.,' vol. ii. p. 420.

needles of pines and larches, but they readily form about such a nucleus as a rope-end. In size, they vary from about two inches to eight or nine inches in diameter.

3. *Balls from the Mediterranean Sea.*—These are formed of fibres of the marine flowering-plant Posidonia Caulini, and were found by Mrs Sprague on the sea-shore at Antibes, to which she made excursions while staying in Mentone—first in 1889, and again in April 1892. The above-mentioned Naiad was growing there very freely in a shallow bay, and specimens of the live plant were procured without difficulty. The balls were lying in very large numbers in a bank, from one to two feet high, consisting principally of fragments of the above-mentioned plant thrown up by the waves. This refuse is said to be used as manure. The fibres forming the balls are apparently woven together by the waves; and the balls, when dry, are of a light-brown colour, and tolerably firm. They occasionally have a nucleus, but seem generally to have none; and they are of very various shapes and sizes, ranging from the size of a marble to several inches across. They are not so uniform in shape as the two foregoing kinds of balls, some of them being oblate spheroids, but they appear to be formed by similar causes. A few partly-formed balls were seen rolling forwards and backwards at the bottom of the water, as the gentle waves advanced and receded—there being very little tide in the Mediterranean.

4. *An oval ball formed of zoophytes, from St Andrews.*—This was received from Professor M'Intosh, of St Andrews University, who says: "It is chiefly formed of Obelia, a rapid grower. I have seen it covering an old felt hat, which appeared as fresh as when worn by the owner. It covers the ropes of salmon-nets, &c., when temporarily in the water, in the same way." The ball is about $3\frac{1}{4}$ inches long by $2\frac{1}{2}$ broad.

5. *A ball of the kind called "Bezoar," from a cow's stomach.*—The ball, which is almost 4 inches long by $3\frac{1}{4}$ inches wide, seems to be principally composed of the cow's hairs, which the creature has swallowed after licking its hide. As far as can be ascertained without cutting open the ball, these hairs appear to be in a manner glued together around some nucleus, each fresh hair being laid on the surface of the ball, which

would thus grow by gradual accretions. The structure of this ball is therefore analogous to that of the Uist balls, but quite different from that of the pine-needle and Posidonia balls.

IV.—*LIMELIGHT LANTERN EXHIBITION.*

BY MR WM. FORGAN, F.R.M.S.

(*Dec. 23, 1892.*)

THIS exhibition comprised a series of slides of decoys and decoy-ducks, lent by Mr W. Eagle Clarke; a series of slides of birds' nests photographed *in situ* from negatives by Dr George Burn Murdoch; and a number of photo-micrographs of microscopic objects,—the whole being exhibited and explained by Mr Wm. Forgan, F.R.M.S. Mr Eagle Clarke's slides were described by means of a very excellent description of these decoys, which was much appreciated by the members. The transparencies from Dr Burn Murdoch's negatives were made for the occasion by Mr Forgan. The negatives were very fine; and when it is considered that there is enormous difficulty in photographing wild birds when sitting on their nests, the patience and skill displayed by Dr Burn Murdoch were all the more wonderful.

V.—*NATURAL HISTORY NOTES.*

AN OTTER STORY.

BY MR TOM SPEEDY.

(*Read Jan. 27, 1893.*)

HAVING accepted an invitation from my old friend Macdonald to spend a few days with him last November, in order that I might procure some snow-buntings and other birds which visit the mountains in the winter months, I wended my way amid considerable difficulty to his house. In consequence of the heavy fall of snow a fortnight previously, many of the burns were drifted full, so that a horse or trap was out of the question. There was consequently nothing else for it but to take as little luggage as possible and carry it on my shoulder. Having fully ten miles to walk from where I left the mail gig, and the road being of a difficult and doubtful character, darkness was setting in ere I reached the end of my journey. It was with no small amount of pleasure that I beheld the light burning brightly in the keeper's house, and heard the barking of his dogs, whose willing ears were attracted by my approaching footsteps. At this juncture Macdonald came out to meet me, and relieved me of my bag. Mrs Macdonald met me at the door, gave me a hearty welcome, and very soon I was comfortably seated at her hospitable board.

After an excellent repast we drew in around a peat fire, while Macdonald related his season's experience among the mountains. Every stag was stalked and shot over again. Every salmon was again hooked and run, and the proverbial "monster" which broke after an hour's play was eagerly depicted. This was all interesting enough; but on his remarking that after the recent fall of snow he observed the tracks of otters by almost all the burn sides, the conversation for me had a special interest. Anxious to make a collection of the rarer of the fauna of our country, and having already procured specimens of the badger, the wild-cat, the fox, and the smaller quadrupeds, I was exceedingly anxious to acquire a couple of otters. This was no easy matter, as I preserve those only killed by my own gun or rifle. The badgers I procured in one of the Border counties by climbing a tree above their "earth" and shooting them at the mouth as they came out in the moonlight. The wild-cats I shot as they were "bolted" from a cairn of stones by fox-terriers, while assisting a keeper in Ross-shire. It was with a feeling of reluctance that I destroyed two of these, the rarest of our wild animals; but the enraged keeper, whose game had suffered the previous season from a couple of broods of wild-cats, declared in emphatic terms that their presence could not, and would not, be tolerated.

To return to the otters. Macdonald, as already remarked, stated that from the tracks he had seen after the recent fall of snow there must be a good many about, and that he had frequently seen one in the deep pool from the top of Crag-an-dhuie. I then suggested that I would load some cartridges with heavy shot, conceal myself by the side of the brook at a shallow place, and, as the moon was nearly full, I should be able to shoot one as it proceeded upwards after daylight had disappeared. Macdonald, however, thought that, as it was only 60 or 70 yards from the top of the rock to the water, I should be able to kill one with the rifle in daylight. Although not so sanguine about this, I nevertheless on the following afternoon took my rifle and proceeded to the crag referred to.

As it was about the end of the shooting season, Macdonald was anxious to send away as many grouse as he possibly could obtain in his weekly hamper to the tenant of the shooting in London. He therefore started early for some distant ground at the extreme end of the shooting, and left me to procure my amphibious specimens as I best could. On arriving at the rocks, I crept stealthily forward in the hope of finding the object of my anxiety in the pool. Nothing, however, was to be seen; so, choosing a sheltered place, I put on my ulster and waited patiently, in the expectation of seeing an otter appear above or at the side of the water. Placing my handkerchief on a bit of rock, it afforded an excellent rest; and, as already observed, the distance to the water was under 70 yards, so that if I got a good chance I had ample confidence in my "Joe Harkom express." Long and anxiously I gazed at the silent pool, but no signs of the otter. A couple of hours thus passed, and as it was clearing up to frost, I sat shivering with cold. Rising up, I proceeded down the hill in order to look for tracks by the brook-side. Plenty of these were to be seen, while a little farther up, on a small island, partly covered with alder bushes, were seven sea-trout kelts, from about three to eight pounds weight, lying dead, with a part eaten out behind the head. This was clearly the work of otters, and the destruction of so many fish afforded a sort of palliation for attempting to kill a couple of them. The sight of so many footprints and remains of fish inspired me with fresh hope, so again I sat down and waited patiently till the shadows of the mountains crept over the landscape.

I now regretted not having my gun instead of the rifle, as I thought I should have had a chance in the moonlight with the former, which with the latter was next to impossible. Not being quite sure of the way across the moor, I resolved to go round by the river, though adding considerably to the distance. As I proceeded, it suddenly became very dark, and began to snow heavily. It was only a shower, however, as in half an hour it had cleared up, and the moon shone out conspicuously. By this time I had passed the junction of the river with the deep corrie burn, crossed the stepping-stones, and was ascending the circuitous path up the steep bank, when I stopped to take breath. Looking down, I saw that the moon was shining brightly on the water, and about a hundred yards below me I observed a dark object paddling up the brook. Taking the rifle out of the cover, I stalked quietly down the hill, keeping my eye on the object till within thirty yards of the water. Having about a minute to wait till it got fairly opposite me, and getting a chance as it swam past me, I aimed as I best could and pressed the trigger. For a second or two I could see nothing, and the "roar" of the rifle, reverberating among the mountains, seemed to be ten times louder than usual amid the silence that prevailed. Running down, I found the otter floating with the current, and wading in, I secured it. The bullet had struck it on the neck and dislocated it, causing instant death. It was a fine specimen of a dog otter, and measured 3 ft. 10 in. from point of nose to tip of tail. I threw him over my shoulder and carried him home to the keeper's house in triumph. Macdonald and his wife congratulated me on my success; and as another shower of snow was falling heavily, he remarked that I might be able to track one the following day, should it be fair weather. Before going to bed the ground was covered to the depth of a couple of inches with new-fallen snow, and as it was frosty and settled-looking, it augured well for success on the morrow.

Macdonald advised me to look the Steelend, the Glenmore, and the deep corrie burns, and to take his retriever with me, he having to go down the country to send his game south. It was unfortunate that I could not get his company and assistance, but, elated with my success the previous day, I took the gun (not the rifle), and, accompanied by the retriever, started in great spirits. Repairing first to Glenmore burn, I had not proceeded far when I came on the tracks of an otter.

Following them downwards, they crossed and recrossed, and sometimes for a considerable distance disappeared at places where the otters had been in the water. After following the tracks for a couple of miles, I lost them altogether. Proceeding to the deep corrie burn, I at once got the tracks of two other otters; one of them had travelled both up and down, and the other up only. Knowing that the best chance would be up, I started to follow the trail. Before going half a mile, the track led among some boulders of stones, where the retriever, in an excited state, began smelling all round. On examining the place, I found where the "varmint" had gone in, and at once thought of going back to the kennel for the terriers. On second thoughts, however, I was afraid it might escape in my absence. What was to be done? I would have tied the retriever at the place till I returned, but had not the means of doing so. I therefore resolved to remove some of the stones, but first took the precaution to have the gun cocked and close at hand in case of a "bolt," it being within twenty yards of the water. After removing more than a ton of rock, &c., I was just about to give it up, when lo! out bolted an otter. Quick as lightning I seized the gun, and before it got to the brook rolled it over with an ounce of No. 4. It was a female, and a beautiful specimen, though not so large as the one got on the preceding evening.

After two additional days spent in the moorland in quest of my ornithological specimens, I returned southwards, highly gratified with my winter's ramble, and proud of the splendid specimens which I had been fortunate enough to obtain.

VI.—*RECENT WORK BY DR J. M. MACFARLANE.*

By Dr WILLIAM WATSON.

(Read Jan. 27, 1893.)

Dr Macfarlane, one of the most enthusiastic members this Society has ever had, has, as most of you know, left his native land, and become Professor of Biology in the University of

Pennsylvania, at Philadelphia. His loss is a great one to Britain as well as to our Society,—a great gain to his adopted country. In memory of old times he has sent me some of his recent papers. He has lately published a most valuable paper on Dionæa muscipula, a common insectivorous plant of North Carolina. Hitherto all observers (except Dr Burdon Sanderson) have erroneously stated that the leaf of this plant closes if you touch one of the leaf-hairs. Dr Macfarlane has shown that this is not correct, and that Dr Burdon Sanderson was right in saying that two hairs must be touched, or that one hair must be touched twice. This is analogous to tetanic contraction of a human muscle. The protoplasm of the leaf seems to retain memory of the first touch for about forty seconds. The first touch does not close the leaf, but prepares it for rapid closure should a second touch occur within half a minute or so. Dionæa, like Drosera, is not affected by rainfall. If a stimulus continues to act on it, as occurs when an insect is grasped, a secretion is poured out from special glands which digests the captured insect. This secretion is acid to litmus paper, and if coagulated by alcohol appears amœboid under the microscope.

Another paper by Dr Macfarlane is on his favourite subject—Hybridisation. Amongst several other plant-hybrids the peculiar characteristics of which, as derived from the parents, he has demonstrated, Dr Macfarlane studied, with praiseworthy skill and labour, a hybrid produced by crossing Lapageria rosea ♀ with Philesia buxifolia ♂. The two plants, though not very like, belong to the same natural family. In the hybrid thus produced Dr Macfarlane found the characteristics of the male and female parents curiously blended in habit, foliage, and flower. If anything, the vegetative organs of the hybrid were more like those of its male parent, and the reproductive organs more like those of its female parent. As a whole, the hybrid was vegetatively superior to either parent. Reproductively, it was inferior to both,—the pollen cells especially looking starved.

Dr Macfarlane's general conclusions on this interesting subject of hybridisation are—(1) Most hybrids are almost exactly half-way between their parents. (2) Structures peculiar to either parent are represented halved in the hybrid.

(3) Some few hybrids lean to one parent. (4) Geum intermedium, an undoubted hybrid between Geum rivale and Geum urbanum, is in every respect a better plant than either parent.

Dr Macfarlane's observations seem to me in accordance with the views held by Strassburger of Bonn, that the great advantage of crossing is that any defect or disease which may have sprung up in one parent is likely to be got rid of by crossing, because it is unlikely that the very same defect will occur in the other parent. At the same time, it is apparently the vegetative organs which are most improved by crossing. The reproductive organs may not be improved, and in some cases they may even be impaired.

VII.—*THE SHIPWORM.*

By Mr WILLIAM COATS.

(*Read Feb. 24, 1893.*)

One of the most dreaded of marine enemies which the ingenuity of man has ever been exercised to encounter, and with such signal lack of success, is undoubtedly the Teredo or Shipworm,—the "calamitas navium" or "terror of ships," as Linnæus termed it; and for the loss of many a stately ship it must be able to account. This animal is notorious for the deadly havoc it makes of the planks and timbers of ships, the piles of piers, docks, and marine woodwork of every description and in almost any situation and climate. An entrance once secured, it honeycombs timber to such an extent as to deprive it of all strength, leaving it, however, with an outward semblance of stability. With such an enemy, working, as it were, in the dark, it is only when disaster or accident happens that the real extent of the mischief is discernible, and its ravages within a decade must represent vast sums in our national expenditure. It has been known, by its effects at least, for centuries. In the following translation we find Ovid—

who was born in the year 43 B.C.—distinctly referring to it:—

> "For as the ship by hidden shipworm spoiled,
> Or as the rock by briny wavelet mined,
> Or as the rested sword by rust is soiled,
> Or book unread, the tiny moths unbind:
> So gnawed and nibbled, without hope of rest,
> By cares unceasing, is my tortured breast."

Upwards of 300 years ago it attracted much attention in Scotland, and many absurd theories were propounded as to its generation, the most absurd being that it was the young of a kind of sea-fowl called klaiks.

By Linnæus the Teredo was classed among the Termes or Worms; nor is this to be wondered at. The long worm-shaped body of the creature would naturally suggest the idea; but Cuvier placed it, as the result of greater knowledge of its organisation, where in all probability it will remain—among the Mollusca, and very closely allied to the better known Pholas.

The Mollusca constitute one of the great animal sub-kingdoms, widely diffused through both time and space, and exhibit so extreme a range of variety in form that it is very difficult, if not impossible, to frame a definition applicable to all of them. Their most prominent organ, the "foot," taken in conjunction with the very general characteristic that their bodies are nearly always of a soft consistence, as the derivation of the term indicates, form the only points in their structure with which the great majority coincide. Their bodies are protected by an external calcareous covering or "shell," hence the popular term "shell-fish" applied to them. This is applied indiscriminately, however, both to Crustaceæ and Mollusca—to the lobster, for example, as well as the oyster. But the shelly envelope has a totally different character in the two cases. In the crustacean the shell is the skin rendered horny or calcareous; in the mollusc, the shell, being no part properly of the body, is the habitation in which it dwells. When it exists it is not to be regarded as an exo-skeleton, giving attachment to muscles and regulating form, but merely as an appendage designed for the protection of the body, or, as in the case of the Teredo, a direct means whereby the animal derives both protection and food. The Teredo and Pholas belong to the class Lamellibranchia (Lat. *lamella*, a thin plate; and Gr. *bragchia*, a gill)—their respiration, which is a characteristic feature, being performed by gills of vascular plates of membrane attached to the inner surface of the mantle. This class of acephalous or headless molluscs is further represented by such familiar examples as oysters, cockles, and mussels. They present, as a whole, a somewhat uniform structure, so that although numerous, their further subdivision is not the result of broadly marked characters. The latest classification refers the Teredo to the order Isomya, sub-order Sinupallia, and family Pholadacea, of which family the Pholas is the type. The majority of the Lamellibranchia may be said to be borers, so far as the power of burying themselves in sand, clay, mud, or gravel can give them a claim to such an appellation. The chief points in which they vary are five:—

1. In the structure of the branchial plates.
2. In the presence of one or two chief muscles or adductors, the fibres of which run across the body from one valve of the shell to the other.
3. In the greater or less development of the posterior portion of the mantle-skirt, so as to form a pair of tubes or siphons, by one of which water is introduced into the subpallial chamber, whilst it is expelled by the other.
4. In the perfect or deficient symmetry of the two valves of the shell; and
5. In the development of the "foot" as a disc-like crawling organ.

The Teredo, then, is a much elongated and worm-shaped abnormal form of a Lamellibranchiate mollusc, measuring in its adult state from a few inches to over 3 feet in length, and living upon the wood in which it burrows. It has a true bivalve shell at the front extremity, the valves are triangular in shape, equal and right and left, very concave on the side in contact with the animal, and their interior is furnished with a long curved process for the attachment of the pedal muscle. They are destitute of a hinge, gape at both ends, afford no protection to the body, but are reduced to mere appendages of, and surround, the short sucker-like foot. The portion of the body behind the shell-bearing part is naked except for the shelly lining of the burrow secreted by it. Anteriorly this portion contains part of the body proper; posteriorly it forms a tube, divided internally by a horizontal partition into two chambers. In the lower chamber are the elongated gill plates, which appear like brown cords. The heart is above the intestine, and not perforated by it. In the upper chamber is the rectum. A thick muscular ring terminates this region, and bears two calcareous spoon-shaped plates, closely resembling tennis rackets. The expanded parts of these plates or "pallets" are free, and project backwards, and the handle is fixed in a deep socket lined by epidermis. Behind the pallets the body bifurcates, forming two siphons, which can be contracted or expanded within wide limits of length, and having the orifices fringed. By this contrivance a fresh supply of water for respiration, and its dismissal when no longer fit for use, with the indigestible portion of its food, are efficiently provided for. The function of the pallets is to form a lid as protection to the retracted siphons. They present a feature of much importance, so far as specific distinction is concerned.

Some writers on Mollusca consider the Teredo diœcious, others as hermaphrodite. As in the oyster, the ova are retained in the branchial chamber during the earlier stage of development; but from the time they swarm and lead a free-swimming existence, to the time when they fasten themselves to a piece of timber and commence to bore, little as yet is known. Spawning takes place in the spring and summer, and before the end of the year they have reached the adult stage, and their burrows are of large size. How long they live is not known, but it is asserted that they nearly all perish in the spring. That this cannot be the case may be argued from the fact that their burrows are so different in size.

There is one point upon which I should like some information—viz., Does an adult Teredo ever manage to leave its bore and seek another piece of timber, or does it die in it? My own opinion is that it dies in its burrow. In support of this opinion, I have not seen any entrance bores but what have been those of the very young animal, and I cannot imagine a more helpless creature than a Teredo out of its burrow, a certain prey to enemies of every kind.

The species which occurs chiefly on the west coast of Great

Britain is Teredo norvegica. Teredo navalis occurs on all the western and southern coasts of Europe, from Christiania to the Black Sea, and is the species causing so much damage to the Dutch embankments. Fourteen species are said to live between low-water to more than 100 fathoms in Norway, Britain, and the Tropics. Species are also known in the fossil state, both by their shells and burrows. The genus is said to have commenced in the Lias, and is well represented at the present day, and in it and succeeding beds twenty-four species have been discovered.

The comparatively harmless Pholas, on the other hand—the family type—whose working assists principally in the disintegration of rocks, has its shell valves open at both ends. From one of the ends the siphons protrude, while at the other is seen the sucker-like disc or "foot." The valves are thin, white, brittle, and covered with regular ridges of teeth. There are also accessory valves, as in the specimens before you. The siphons are often united almost to the end, and the outlet tube indicates its function with a minute explosion in the water. They are popularly known as Piddocks.

It may not be out of place to refer in passing to two other timber-boring pests—viz., the Limnoria terebrans and the Chelura terebrans. The Limnoria terebrans, or wood-borer, resembles a wood-louse, is not so rapid in its work as the Teredo, but as certain with its results, and while the Teredo is attacking the interior of a pile, the Limnoria may be destroying the surface. The late Robert Stevenson, who is credited with the discovery of this crustacean during the building of the Bell Rock lighthouse in 1810, established a regular series of observations there, beginning in 1814, and tested the ability of many kinds of timber, under like conditions, to withstand this borer; the result being that while it destroyed most kinds, greenheart, beefwood, African oak and bullet-tree were scarcely attacked, while teak and locust-tree stood remarkably well.

The Chelura or wood-boring shrimp is much more destructive than the Limnoria. It does not bore very deeply below the surface; and when the undermined portion is washed away by the sea, it makes a fresh attack, and the timber is thus destroyed in successive layers. The Teredo and Limnoria are found to eat most rapidly between the bottom and low-water mark, but above low-water the damage is not so great, and they do not appear to exist at all below the bottom. Another opinion is to the effect that timbers which are alternately wet and dry are destroyed much faster than those constantly immersed.

The small shells constituting the formidable boring apparatus by which the long tubular burrows are excavated are peculiarly fitted for the performance of this special duty. Examination under the microscope reveals the fact that the very fine lines on the shell, seen by the naked eye, and of which there are two sets running at right angles in each valve, resolve themselves into rows of teeth. On the broader part they are serrated, while on the narrow part the teeth are larger, somewhat rounded in shape, and slightly separated from each other, but there are exactly the same number of rows in the broad as in the narrow part. These teeth cut in a backward direction. This also is evident by examination, and even by touch. Although direct observation of the animal in the act of boring has perhaps never been enjoyed, it appears to me that the cutting lines of these four sets of teeth must cross each other at two different angles, and, coupled with the ceaseless circular or half-circular motion which must of necessity go on, and the constant renewal of the lines of teeth from behind as these are worn away in front, it is enabled to rasp away very hard timber; and the wonder increases rather than lessens, how, by tools so insignificant, so fragile, and a muscular force so trifling, such disastrous and terrible results ensue.

The borings, after an entrance has been effected, are generally made in the direction of the grain, except when a knot is met with, which, being evidently too much for them, they go round about. They usually occur in considerable numbers, often crowded together, so that but a very thin partition separates the adjacent burrows. They further appear to have the faculty of knowing when they are boring into the tube of a neighbour, or if the plank be thin that they are coming through altogether. From the specimens it will be seen that the bore in such cases forms a small *cul-de-sac*, and that the Teredo has withdrawn a little and begun afresh. The cavity by which it enters is very small, and the bore for a short distance goes across the grain. As it grows rapidly, it enlarges the diameter of the bore, at the same time lining it with a smooth calcareous incrustation, which forms a tube apparently to protect its soft body. This lining appears to be much thicker in some species than in others, and by the very young animal is deposited in transverse ridges. In the Teredo gigantea the calcareous tube, said to exceed 6 feet in length, has walls estimated to be from 4 to 6 lines in thickness. The excavation formed by the rock-boring Pholas, on the other hand, is of a short elliptic form, broader at the bottom than the top, and is designed only for protection. As seen in the blue shale of Port Seton harbour, where they are in hundreds, their burrow is beautiful in its regularity.

Various and contradictory views have been brought forward from time to time regarding the actual boring agent of the Teredo. It has been held that it bores by means of its shells, fixing itself by its sucker-like foot and rasping the wood by the toothed edges of the valves. A second view is, that the excavations are due to the action of a solvent secreted by the animal, which thus acts as a pioneer in mining the passage, afterwards increased to its final dimensions by the valves. A third theory is, that the excavating power is due to siliceous particles imbedded in the anterior portion of the disc; while a fourth is, that the "foot" is the organ alone by which it is accomplished. Arguing from what can be seen in the case of the Pholas, it is certainly the shell, and the shell only, which gives the bore its greatest diameter; and although a fragile substance, it can, by ceaseless action, coupled with the constant renewal of its teeth, make its way into very hard rock. If this result be accomplished by the Pholas, we may safely attribute the boring in the case of the Teredo to its shell, assisted by the sucker-like foot, from which, used as a pivot or fulcrum, the necessary purchase is derived.

Coming now to instances of destruction, these might be multiplied indefinitely, but one or two historical examples will suffice. Along the west coast of the Netherlands, the low-lying lands are protected by a line of sandhills or dunes; and where this natural defence is wanting, strong dykes have been constructed, and are kept up at great expense to prevent the encroachments of the sea. Great consternation must have prevailed on several occasions when it became known that the dykes were giving way, through the destruction by the Teredo of the supporting piles. The species with such an evil reputation is referred by some Dutch naturalists to the Teredo Sellii—named after the Dutchman Godfrey Sellius, who wrote a treatise on the animal—a small quarto of 360 pages. Piles driven only six or seven weeks previously were seen to be entirely eaten through and robbed of all their strength. In this way the island of Walcheren was in 1733 threatened with destruction. From time to time the same danger was discovered in other places, especially on the Zuider Zee, and West Friesland was in consequence forced to mask its dykes with large stones, which occasioned great expense, as they had to be brought from abroad. Many remedies were tried, with little if any success. The Teredo itself, however, abandoned the work, and a feeling of greater security immediately resulted.

An interesting instance of the utility of the Teredo in assisting to inflict punishment on an enemy, but one which in these days of iron ships and ironclads will not likely be repeated, is given by Rear-Admiral Colomb in his valuable work on 'Naval Warfare.' He says that in 1588 the English Admirals, Hawkins and Frobisher, paralysed to an irrecoverable extent the whole West Indian trade of Spain by simply lying across the Spanish "trade-route," and preventing for a whole year the sailing of the Spanish ships from the West Indies. The imprisonment of the ships was a heavy enough blow. "But in this case," he continues, "it was still worse for Spain, as in the then unsheathed state of ships' bottoms, lying in tropical waters for a summer produced weakness of structure almost amounting to disablement, from the ravages of the Teredo. As a consequence, about a hundred of these detained ships were lost with their rich cargoes on the return voyage to Spain next year." During the Crimean war British gunboats suffered in a like manner as much from dry-rot and Teredos as they did from the shot and shell of the Russians.

In the 'Scientific American' of 25th April 1891 it is stated that in the year 1884 one of the large saw-mill companies of Puget Sound lost 50,000,000 feet of logs, equal to

1148 acres of square timber, that were allowed to lie in the water till the Teredo had ruined them. Puget Sound is a collection of inlets forming a harbour of about 15 square miles to the south-east of Vancouver Island. It is particularly infested with Teredos, and at Tacoma, Seattle, Victoria, and other points on its shores, docks have been cut down in a year's time, causing heavy damage, expense, and loss of life; and although somewhat extreme, the opinion is held there that after six months a pile is unsafe. A special instance, however, of the rapidity with which mischief is done has been cited from Seattle, where a pile taken from a raft waiting to be used in the building of a wharf was found useless. It had been in the water only thirty days, and a section of it, about a foot across, contained 212 holes by actual count. When this log was placed on the beach, it is said that on putting the ear near it the sound was like that of a saw-mill in actual operation. In England, Southampton Water is much infested by them; and in our own country two of the worst parts are Lerwick and Castlebay in the Hebrides.

Long experience has confirmed the fact that two of the best known and most extensively imported timbers for shipbuilding and marine engineering purposes are greenheart and teak. These do not, however, thoroughly or altogether withstand the attacks of the Teredo, but they appear to be among those least subject to them. This may be due partly to their close-grained hard nature, and partly to the oil with which both woods are permeated. Greenheart, so called from its colour when sawn up, is the timber of the Bebeeru, a tree belonging to the natural order Lauraceæ, a native of Guiana. It has a clear stem, attaining a height of 40 to 50 feet, with a diameter of between 2 and 3 feet, and is imported in logs of from 12 to 16 inches square, and from 20 to 40 feet in length. It has a medicinal bark, yielding the sulphate of bebeerine, not much used now, however. By subjecting greenheart *wood* to a process identical with that used for the extraction of the sulphate of bebeerine from the *bark*, a product is obtained of an intensely bitter taste, not differing perceptibly from the sulphate itself. This may account for wounds produced by splinters of greenheart not readily healing.

Teak is one of the most valuable of the timbers produced in the East Indies, and vessels built of it have been known to last from thirty to fifty years. In weight it is much lighter than greenheart. The specimens exhibited were cut to the same dimensions, and weigh respectively 3 lb. 8½ oz. and 2 lb. 8½ oz. Two years ago, when fresh cut, they weighed 4 lb. 13½ oz. and 3 lb. 6½ oz. Like every other kind of timber, teak is liable to premature decay if not properly and gradually seasoned. Indian teak (*Tectona grandis*) is the produce of a tree of the order Verbenaceæ. African teak, or rather African oak, belongs to the Spurge family. Its timber is too heavy for general use, but it is adapted for steam-vessels, as it stands a great degree of heat. The teak grown on high, dry, and open land is generally of a fine quality, close, compact, and abounding in a mild oil, which exerts no injurious effect upon the iron bolts driven into it. That grown in the dense forests of the wet, low-lying alluvials, on the contrary, is lighter, coarser grained, and contains an acrid oil, which not only affects iron very materially, but even to a certain extent poisons and inflames the hand pierced by its splinters. As every one knows, the Indian teak forests are now under Government protection.

Many remedies have been tried, and expedients resorted to, in order to baffle the Teredo, but the majority of these have resulted in failure. Curious poisoning compounds, coal-tar, and even the antiseptic or preserving power of creasote, though the timber be still black and emitting its pungent odour, are unable totally to prevent it. The only absolute method of prevention is to replace timber structures with stone or iron; but the element of increased cost at once steps in, even if the material be readily obtainable. Copper and yellow-metal sheathing for wooden ships has long ago become a *sine qua non.* Even with copper sheathing, where only partially carried out, Teredos have caused extensive damage above the water-line. Copper-sheathing and scupper-nailing are often successfully employed as protection for piles. The scupper or broad-headed nails are driven so closely as almost to touch each other, corrosion takes place, and the oxide of iron, entering into the outer skin of the wood, renders it hard enough to resist the animal. Green twigs of pine or other wood placed among piling have been tried with some success in Sweden. Breaming or scorching timber, and saturating it while hot with a mixture of whale-oil and thin coal-tar, also forms a temporary protection. In many instances creasoted timber has been used with great success, although not a certain safeguard, as in 1863 a large number of creasoted harbour-piles at Christiania were entirely destroyed. The cleaving of fir piles with thin boards was resorted to some years ago at Lerwick harbour, and this device was found fairly successful. Impregnation of timber with water-glass has been tried in the Brooklyn navy yard with satisfactory results, but little further has been heard of the process. Casing piles with wooden boxes, the space between being filled up with cement, has been found successful, but of course the boxes themselves are soon riddled.

It is known that so long ago as the reign of Trajan, who became Emperor in 98 A.D., sheathing of lead, fastened with copper nails, had been used as a protection for galleys from the devastating animals of the Mediterranean.

As it contains the latest suggestion for prevention, and as showing to what an extent this pest must enter into the business calculations of some communities, the following extract from the 'Portland Oregonian' may be of interest:—

"In the office of the Oregon Improvement Company are a number of cans of some poisonous compound intended to prevent the terror of Puget Sound, the Teredo, from destroying piles or other timbers placed in the water. The stuff is to be sent over to the Sound to be tested. A number of things have been tried, such as creasote, asbestos, coal-tar, castor-oil, strychnine, &c., but the only sure method for preventing the Teredo from eating up piles is to make them of iron. Covering wooden piles with copper will protect them as long as there is no place in the joints of the copper where a Teredo can poke his nose through; but if once the copper gets torn, it is good-bye, John, to the pile. So far, the poisonous compounds used seem to have pleased the Teredo much, seeming to act as a condiment on what must be rather a monotonous bill of fare, and assisting in its digestion. The man who finds out the poison which will act as an antidote will have a good thing. It may be that if the piles were washed with whale-oil soap every day, it might keep away the Teredo; or if they were greased with tallow, perhaps the long, slimy, wriggling pest might not be able to get its teeth into the pile, as they would slip off. The people on the Sound can rejoice that the Teredo does not go ashore and hunt for tall timber, as, if it did, the lumber output of that section would soon be nil. It might be that if the saw-mills on the Sound would throw their sawdust into the Sound, the Teredo would learn to like it, and would prefer 'cut-feed' to cutting up the piles themselves, and thus some good might be accomplished."

These borers evidently haunt certain localities, as fish do, without any reason as yet known. But in many instances there may be local causes for their non-appearance, such as swift currents from tides, rough water caused by continuous winds, or an admixture in quantity of fresh with sea water. With such a pest, we are very apt to ask the question, What can be the use for it? The only redeeming quality that can be set against all the evil it does, is that it attacks floating wreckage as readily as other timber, and, by its weakening action, coupled with the force of waves, breaks up derelicts and floating masses of timber, which would otherwise constitute serious and dangerous impediments to navigation. From the lowest to the highest grades of animal life, we find ample provision made for the exigencies of existence, in so far as these demand the use of apparatus giving its possessor some advantage or other in the "struggle for existence," but we wonder what the Teredo has to contend with, or who are his natural enemies—unless it be man—once he has ensconced himself in a long timber pile.

Specimens illustrating the above Paper.

1. Teredos in bottle taken from wreck.
2. Planking of boat bored by Teredo.
3. Teredo norvegica in tube.
4. Shells of Teredo.
5. Shell lining of burrow in a large piece of timber.
6. Pallets of Teredo.
7. Pholades from Port Seton.
8. Shells and accessory valves of Pholades.
9. Limnoria in tube.
10. Log bored by Teredo and Limnoria.
11. Timbers, pine and greenheart, bored by Teredo and Limnoria.
12. Toredo valves under microscope.
13. Floating timber bored by Teredo.
14. Blue shale, &c., bored by Pholas.
15. Blue whinstone bored by Pholas.
16. Specimen of greenheart.

17. Specimen of teak.
18. " greenheart, Dunoon Pier.
19. Sulphate of bebeerine.
20. Pine and elm from wreck bored by Teredo.

VIII.—*THE KAME AT MORTONHALL.*

By Mr THOMAS WRIGHT.

(*Read Feb. 24, 1893.*)

In going from the village of Liberton towards the south, the pedestrian passes Alnwickhill reservoir and St Catherine's Well, and then reaches the roadside hamlet known as the Kames.[1] These cottages take their name from the long ride of gravel which runs through the park on the west side of the road. In Ireland the name *esker* is applied to gravel ridges; in Scandinavia they are *osars;* in the Northern States of America they are locally known as hogbacks, horsebacks, or whalebacks; but geologists have adopted the Scotch term, so they are usually called *Kames.*

The finest examples in Europe are to be found in the long valleys of Southern Sweden. Sometimes a long winding bank of gravel and sand extends over 100 miles, and the dominant ridge is joined by smaller ones from the tributary valleys, as a river is by its affluents. They are also to be met with on a smaller scale in the wilder glens of Norway. The tourist who sees one for the first time is puzzled by its appearance, and asks if this is an old rampart. Very pretty, indeed, are these flat-topped ridges during the bright Norwegian summer. They are ablaze with hemp-nettles and crane's-bills and pansies, which for size and colour could give points to British specimens at a wild-flower exhibition.

In regard to the formation of Kames, various opinions have been held. The late Mr Milne-Home, in his book on 'Ancient Water-Lines,' expresses the belief that "they were formed by sea-currents out of pre-existing drift on the sea bottom."

[1] It is needless to add that *Kame* is Scotch for comb or crest.

Other writers have endeavoured to prove that they must have had a mixed river and sea origin; but Professor Geikie, in his 'Great Ice Age,' advances very strong reasons for rejecting both of these theories. He contends that the formation of Kames is due to glacial action. The streams of water arising both from the rainfall and from melting ice produce a peculiar effect about the foot of an extensive glacier. Sometimes these streams cut long open channels in the ice, and sweep into it vast quantities of morainic material, which is pushed along by the current, and, after being abraded, rolled, and sorted, is deposited in a delta about its mouth, or left stranded in long lines between the ice-walls. At other times, the stream has disappeared far back in the glacier, and plunged into a crevasse, whence it flows onwards as a sub-glacial stream. In this case it must often happen that the weight of stones and rubbish will cause the roof of the tunnel to collapse, and the result will be the deposition of a ridge which will come into evidence when the ice melts away. It was in 1876, I think, that Professor Geikie offered this explanation. Since then, absolute proof has been obtained which verifies the sub-glacial stream origin in every detail. The Muir Glacier lies at the head of an inlet in Glacier Bay on the coast of south-eastern Alaska. It was discovered in 1879, and has proved a valuable "find" for American geologists ever since, as glacial action can be studied there to admirable advantage. Dr Frederick Wright, author of 'The Ice Age in North America,' spent the entire month of August 1886 encamped at the foot of the glacier. He witnessed the formation of long ridges of gravel exactly as described by Professor Geikie. To put it in a sentence: a Kame marks the line of drainage from a glacier, and is a mute witness of the former existence of ice-fields.

Recurring to the Kame at Mortonhall. Although countless tons of gravel have been taken away, the ridge is still about 1000 yards long. The eastern point reaches the tumble-down cottages called "Five Houses." It runs in a north-westerly direction about half its length, then turns sharply due west and extends to the ice-house belonging to the laird of Mortonhall. No doubt it formerly occupied a much longer track in the low ground lying between the Pentlands and the Braid

Hills, but west of the mansion-house it seems to have been "improved" away altogether. Perhaps some of our members who reside in the Colinton district may have observed gravel mounds in their neighbourhood, and will be able to say how far the Kame extended in that direction. Making a rough guess, the average height of the ridge is 30 feet, with a width at the base varying from 50 to 100 yards. Beech-trees grow on the top, but only attain a moderate size. The stones which go to build up the Kame are mainly felstone (sometimes called quartz porphyry), and smaller quantities of a coarse-grained red sandstone derived from local sources. Mr John Henderson, well known to us all as a skilful local geologist, was kind enough to go over the ground with me lately, and he is of opinion that the material has been carried from the Braid Hills. We failed to discover any glacial striæ on the stones. Only a few are angular, the great mass being rounded and water-worn, thus indicating a long process of abrasion in the torrent.

In writing this brief note, my aim has been, not so much to give a detailed account of the Kame, as to invite your attention to an interesting item of local geology. Within an hour's walk of the city we have a memorial of the glacial period—surely one of the most attractive epochs in geological history. The endeavour to spell out the hieroglyphics which old-time ice-sheets have carved upon the rocks is an absorbing study, and if we are loyal to the teaching of fact, glaciers that now exist (although but shrivelled up remnants of their former selves) will guide us to right conclusions. Their methods of operation are always the same, although the extent is curtailed. We are apt to think of the glacial period as being severely rigorous and desolate—a time when animals and plants had either to migrate southwards or perish. While this was so, we may do well to remember that moving masses of ice did a great work in fertilising the plains. They carried rocks from the mountains, pulverised them, and spread the grist over the lowlands. Wherever the glacial drift has been carried, there the land has been greatly enriched, and made fit for the occupation of man. The American farmer is raising wheat on soil laid down by this mighty distributor, and as a result, we are getting cheap bread. So in one respect, at least, things are better for us than they might have been, had not Mother Earth passed through a great Ice Age.

At this meeting Mr Hugh Fraser gave some interesting "Notes on the Holly," illustrating his remarks by a large number of specimens. Dr John H. Wilson also gave a lantern lecture on Plant-hybridisation, dealing especially with some remarkable hybrids raised by himself at St Andrews.

IX.—*ON MICROSCOPICAL MEASUREMENT.*

By WM. FORGAN, F.R.M.S.

(*Read April 28, 1893.*)

Three different and distinct things are embraced in this subject, and may be taken in the following order:—

Firstly, How to measure the size or diameter of any microscopic object. To do this, it is necessary to have a stage micrometer, ruled either with $\frac{1}{100}$ths and $\frac{1}{1000}$ths of an inch, or, as is done on the Continent, one millimetre ruled into a hundred. A divided scale is also required to drop into the eyepiece, but this scale does not require to be ruled in any particular way, if only the divisions are equal. Then, when the stage micrometer is on the stage and the divided scale in the eyepiece, with a certain length of tube, if it is found that the $\frac{1}{100}$th of an inch on the stage covers, say, five divisions on the eyepiece, you know that, with that particular length of tube and object-glass, each eyepiece division must represent the $\frac{1}{500}$th of an inch. Then, removing the stage micrometer, place an object on the stage, and if in its breadth or length it fills one of the eyepiece divisions, it must measure the $\frac{1}{500}$th of an inch. If it fills two eyepiece divisions, it must then be the $\frac{1}{250}$th of an inch, and so on. It is well to find out the value of these eyepiece divisions for each object-glass and write them down on a card, to be placed in the microscope box; and if you adhere strictly to the same length of tube, the stage micrometer is not needed again.

Although this is one way, and perhaps the best, the size of objects may be got in another way, and one giving equally good results. In this method only a stage micrometer is required. First, the image of the object must be projected down, and drawn, or at least the outline, upon paper or cardboard, while the microscope is in a horizontal position. The drawing is effected by means of a camera lucida, a simple form of which may be a thin cover-glass attached to the eyepiece end of the microscope, at an angle of 45°. You can do this by taking, say, a pill-box, which will fit the eyepiece end of the instrument, and bending back the bottom of the box to the above angle. Making a hole in it fully a quarter of an inch in diameter, lay the cover-glass on the inside sloping surface. Then, looking perpendicularly down through the thin glass, the image of the object will be reflected up into the eye, while a virtual image will be projected down on the paper. On taking a pencil, this image may be drawn on the paper. Now remove the object from the stage of the microscope, putting in its place the micrometer, and, as was done with the object, draw the micrometer lines, and you have the size of the object shown by these lines. In doing this, it is not necessary to place the microscope at any particular height above the paper, because the object and the lines are precisely at the same distance, and the value of each is the same.

Secondly, How to ascertain the magnifying power of your microscope. To do this, only a stage micrometer is required. You put this on the stage, and inclining the microscope as before, using the camera lucida or cover-glass, fitted as above described, project the image of the micrometer lines down on the paper. In doing so, the proceeding is totally different from that described under the first heading. In this case, the eye lens of the microscope must be placed at precisely ten inches from the paper. If you do this, and use, say, a half-inch object-glass, with, of course, any eyepiece, the $\frac{1}{100}$th of an inch on the stage micrometer will cover one inch on an ordinary rule. You then know that, with that particular object-glass and eyepiece, the magnification is 100 times. If the $\frac{1}{100}$th of an inch covered a space on the paper equal to half an inch, the magnification would be 50 times, and so on.

It will be seen from the above that the question of the size of an object and the magnifying power of the instrument are two totally different things. Some try to find out the latter in a simple way, by looking through the microscope with one eye, while they glance with the other eye at a foot-rule placed at the distance of ten inches. I should recommend no one to do this, because in a great many cases the right and left eyes are not of the same focal length, and the values obtained in this way may be quite illusory. Ten inches is the recognised focal length of a normal human eye, and that is why the virtual image requires to be projected at that distance.

Thirdly, there is another measurement to be noticed—viz., How to ascertain the magnifying power of each object-glass by itself alone—or, as it is termed, its initial magnifying power. To do this, we require again a stage micrometer, and in this case we also require an eyepiece micrometer, both accurately ruled to a given scale—say for the stage one, a millimetre ruled into a hundred divisions, and for the eyepiece one, five millimetres ruled into fifty parts. Place on the microscope any object-glass you wish to measure, the stage micrometer being on the stage, and the eyepiece micrometer in the eyepiece. Now remove the field lens of the eyepiece, and lay it aside, as you require the eyepiece with the eye lens only remaining in it. The image of the divisions of the stage micrometer as magnified by the object-glass reach the eyepiece micrometer without the intervention of the field lens, and their magnified image can be got at once. Suppose five divisions of the stage micrometer cover ten divisions in the eyepiece—as these eyepiece divisions are ten times coarser than the stage ones, multiply them by ten, and divide by the number they represent on the stage divisions, and you at once get the power of your object-glass by itself, thus—

$$\frac{10 \times 10}{5} = 20.$$

So that the object-glass upon which this experiment was tried has a magnification of twenty times by itself alone, and is therefore what is termed a half-inch objective. In this measurement the distance between the stage micrometer and the eyepiece one should be ten inches.

It is hoped that the above notes on a particularly dry subject will be found intelligible, as well as useful, to those members of the Society who work with the microscope.

EXHIBITS IN NATURAL HISTORY.

THERE were exhibited throughout the Session, at the winter evening meetings of the Society, a large number of interesting objects connected with Natural History, the principal of which were the following:—

BY MRS SPRAGUE.

Edible Birds'-nests.—The nests exhibited were three in number, one of which was white, or rather pale yellow, and very free from extraneous matter; the others were much darker, and contained many feathers, which seemed to have been intentionally used by the bird in constructing the nest. The nests are composed of the salivary secretion of the bird. The white ones are the first that are made each year, while the secretion is copious; and the less pure specimens are constructed after the first-made nests have been removed. The birds which build these nests belong to the genus *Collocalia*, or Swiftlet, of which there are many species. Judging from analogy, probably each species makes a nest with peculiarities of its own. The largest of the three nests exhibited was about 2 inches wide and 2½ inches long; and in each of them the successive layers by which the nest was built up, could be distinctly traced. The nests are made into soup, which is highly esteemed by the Chinese, and is sometimes introduced as a curiosity at the dinners of Europeans resident in the East.

Poppy-heads pierced by Tomtits.—Small birds, as is well known, are very fond of poppy seeds, which are sold under the name of maw seed; and the tomtits, having discovered that these palatable seeds are to be found in poppy-heads, make a practice every autumn of boring holes in the ripe poppy-heads in the garden at Marchfield, Davidson's Mains. Mrs Sprague has repeatedly seen them at work, clasping the flower-stalk just below the capsule, and boring holes into the latter.

Trap-door Spiders' Nests.—These were procured by Mrs Sprague during a residence at Mentone in 1889. They are common in the olive terraces there, but can only be discovered by close observation. The existence of one is indicated by a very faint circle in the hard ground under the olive trees; and the lid, which is perfectly flush with the ground, can be easily raised with the help of a pin or a penknife. The spider's nest, or rather burrow, is cylindrical; and the lid is made to fit the aperture exactly: it is composed of a number of circular layers of small grains of earth, compactly fastened together by the spider with its web.

A Drift Seed, regarded as a Charm in the Hebrides.—This seed was presented to Mrs Sprague by the Rev. Dr Alexander Stewart ("Nether Lochaber"), who writes regarding it: "It is held to be of great efficacy by the people of the Outer Hebrides (mostly Roman Catholics), in the alleviation of the pains of labour in women, and in infantile ailments. It is locally known as 'Airne Moire'—the Virgin Mary's kidney. The first idea of its sanctity probably arose from the natural cross to be seen on one side of it. It is in reality the seed of a shrub that grows in Jamaica, which falling into a stream is carried to the sea, and eastwards by the Gulf Stream, till it is picked up on the western shores of the islands of Barra and the Uists. It occurs so rarely that it was with great difficulty I secured this specimen. So far as I could discover, there are only some 12 or 13 of them in all the Hebrides. The seed was sent to Kew Gardens to be named, and proved to be Ipomœa tuberosa." In the 'Annals of Botany,' vol. vi. p. 369, there is an interesting paper on this seed by Mr W. B. Hemsley, F.R.S., Principal Assistant in the Herbarium at Kew.

Tortoise-like Beetles.—These beetles are from the Lower Himalayas, below Darjeeling. Colonel Sconce states that they have a very brilliant appearance during life, the dark parts of the body shining like a glow-worm at night, and having a sheen of green and gold during the day. They have a striking resemblance to a small tortoise: possibly this may be a case of protective mimicry.

A Pod of Tree-cotton from South India.—Dr William Watson gives the following information as to tree-cotton. The ordinary cotton of commerce, he states, is obtained from a shrub called Gossypium herbaceum; and tree-cotton is a term applied to the fibres obtained from an allied shrub, Gossypium arboretum, D.C. This latter fibre is of no commercial importance. The pod exhibited is from a common Indian tree, Bombax malabaricum, which grows to a height of 150 feet in Himalayan valleys. It is found all over India and Burmah. Without doubt this is the cotton of Ctesias and old Greek writers.

By Mr Symington Grieve.

Skin of the Wolverine (Gulo luscus, Sabine; Ursus luscus, Linn.).—The skin exhibited was a very fine specimen obtained from a trapper at Glacier, in the Selkirk Mountains, British Columbia. The wolverine has a very wide distribution, and is found throughout the whole northern parts of the American continent. It is found as far south as 39° in the Rocky Mountains, and has been met with in New England and New York State. By some naturalists it is supposed that this is the same animal as the Glutton of Northern Europe, the *rossomak* of the Russians. The Wolverine seems to inhabit high northern regions, as its bones have been found on Melville Island, which is about 80° N. lat.

Roman Amphora.—This was discovered during some excavations at the King's Head Tavern, Moscow Road, Bayswater, London, about the middle of June 1892. The double-handled Amphora is in perfect condition, and was dug up while some workmen were excavating a cellar. When discovered, it was resting in a deposit of what appeared to be small limpet shells, and great numbers of these shells were adhering to the outside of it. A gentleman who was passing at the time acquired the jar, and afterwards gave it to Mr Grieve. By request he made some further inquiries regarding the excavations, and informed Mr Grieve that a few feet below where the Amphora was found the workmen came upon a huge flat stone lying in a slanting position, and weighing many tons. This was examined by several scientists, and pronounced to be an old Druid stone, but the informant did not state any reasons for their arriving at such a conclusion. This stone the workmen cut in half, so as to level it, and it now forms part of the cellar floor.

Skin of "Timber" Wolf (Canis lupus, *var.* griseus of Richardson).—This is the common Grey Wolf, called in British Columbia the Great Timber Wolf. Mr Grieve purchased two very fine skins of it from a trapper at Glacier, Selkirk Mountains, British Columbia, one of which was exhibited. These animals vary considerably in size in different localities, but those met with at Glacier are large. They are very fierce and dangerous when pressed by hunger in winter, and every means is used to try and destroy them, but poison appears to be the most successful method.

By Mr Wm. Forgan, F.R.M.S.

New Photo-Microscopic Camera and Microscope for photographing Microscopic Objects.—This apparatus was shown, and the method of using it fully described. The chief peculiarity was the use of magnesium ribbon as the illuminant—a method of lighting the objects to be photographed devised by Mr Forgan. This was done by burning the ribbon, pushing it as required through a small piece of brass tube previously fixed in a shutter so as to be always in the centre of the optical axis of the instrument. Sir Henry Roscoe states, in his book on Spectrum Analysis, that magnesium is peculiarly rich in purple and violet rays. It is therefore the very best illuminant for affecting the photographic plate. Exposures, therefore, which would require with a good lamp from five to ten minutes, may be made with magnesium in as many seconds.

By Mr William Coats.

Slide showing Contents of Alimentary Canal of Dragon-fly.—Here there were seen portions of heads, eyes, antennæ, legs, wings, &c., of insects captured by the dragon-fly while on the wing,—clearly demonstrating the rapacious nature of the animal in its perfect condition.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Society was held on the evening of October 27, 1893, at 20 George Street—Dr T. B. Sprague, President, in the Chair. The Treasurer reported the income for the Session to be £35, 19s. 10½d., and the expenditure £32, 17s. 3d., leaving a balance of £3, 2s. 7½d. The publication of the Transactions of the Society, on the recommendation of the Council, it was resolved to hold in abeyance until the funds were in a more prosperous condition. The usual indoor meetings were reported as having been held during the winter; while excursions were made in summer to the following places: May 6, Ratho; May 13, North Berwick; May 27, Dunfermline; June 3, Linlithgow and Caribber Glen; June 10, Lochleven; June 17, Ormiston Hall; June 24, North Queensferry; July 1, Melrose Abbey; July 8, Balerno; July 15, Gosford.

The following Office-bearers were elected at the meeting: Dr T. B. Sprague, President (re-elected); Mr J. A. Johnston, Vice-President; Mr A. Moffat, Secretary and Treasurer (re-elected); Mr J. Lindsay, Editor and Librarian (re-elected); and as members of Council, Messrs T. W. Kilgour, T. Wright, and G. L. Moffat.

SESSION 1893-94.

I.—*THE ROSE, THISTLE, AND SHAMROCK.*

By Dr WM. WATSON.

(*Read Nov. 23, 1893.*)

On the side of the cross-road from Fairmilehead to the village of Colinton there is a marble slab, erected by the late Mr Macfie of Dreghorn. On this slab verses of poetry are inscribed to the memory of General Gordon. One verse runs thus—

> "Rose, thistle, shamrock, and the modest leek,
> Are one in feeling what they may not speak."

Taking this as my text, I wish to consider how the rose, thistle, shamrock, and leek came to be the emblems of England, Scotland, Ireland, and Wales, and what species of each of these plants is specially representative of the four nations.

With regard to the rose, there are five common species in Britain: the burnet-leaved Scotch rose (*Rosa spinosissima*); the villous rose (*Rosa villosa*); the sweetbrier (*Rosa rubiginosa*); the dog-rose (*Rosa canina*); and the close-styled rose (*Rosa arvensis*). The first four are generally red, the last is generally white; though, as Dick of Thurso says, "many roses tend to be red and hairy in dry years, white and smooth in wet years." Still, as a general rule, four of them are red and one white.

If we are to accept Pliny as an authority, we must consider

Rosa arvensis to be the rose of England, for he derives the name of Albion from the white rose—"Albion ob rosas albas." Shakespeare, in "Henry VI., Part I.," Act ii. sc. 4, leaves the question more in doubt. He makes four of his characters, York, Warwick, and two lawyers, pluck a white rose from a brier; and two, Suffolk and Somerset, pluck a red rose from a thorn.

Not very far from the marble slab above mentioned is a building on the roadside — not its first site — a sandstone gateway, carved with intermingled roses and thistles. It was originally erected in the time of James V. I have examined this slab carefully, but the roses on it are mere conventional, heraldic roses, like nothing in nature. Many of them have only four petals.

Dunbar's poem, "The Thistle and the Rose," decidedly favours the opinion that the rose of England is the white rose (*Rosa arvensis*).

Of thistles we have ten species in Scotland, belonging to three genera: the musk thistle (*Carduus nutans*); the welted thistle (*Carduus acanthoides crispus*); the slender-flowered thistle (*Carduus tenuiflorus*); the milk thistle (*Carduus Marianus*); the spear-plume thistle (*Cnicus lanceolatus*); the marsh plume thistle (*Cnicus palustris*); the creeping plume thistle (*Cnicus arvensis*); the woolly-headed plume thistle (*Cnicus eriophorus*); the melancholy plume thistle (*Cnicus heterophyllus*); and the cotton thistle (*Onopordum Acanthium*). Carlina vulgaris is also found, but it is exceedingly rare, and may therefore be left out of consideration. There is one other British species, Cnicus acaulis; but it is only found in Dorset, Norfolk, and Essex, so it can hardly claim to be the Scotch thistle. At the same time, one legend makes it out as being the true Scotch thistle. The legend is — that a party of Danish marauders had nearly succeeded in surprising a Scottish camp, when one of the Danes trod on a thistle, and gave a scream, which awoke the Scotch sentry, and thus saved the army from destruction. This story best suits Cnicus acaulis; but if so, it must have been an English camp, not a Scottish one. The scene must have been Norfolk, not Fife.

The other chief claimants are—(1) Carduus Marianus, found at Dumbarton, but not common in Scotland. This has in its favour the fact that it undoubtedly was a sacred plant, the white veins on its leaves having been believed to have been produced by a drop of the Virgin Mary's milk, just as in pagan times a drop of Juno's milk was supposed to be the origin of the Milky Way. It also most resembles the "bawbees" of James V. and Mary, as seen in the coin collection in the Museum of Science and Art. (2) Onopordum Acanthium, which is cultivated in gardens as the Scotch thistle, and which, with the possible exception of Cnicus eriophorus, is the handsomest plant of the group. This plant is stated by Sir Walter Scott, in a "Letter to Lord Montague," to be the Stuart badge. If this is actually the case, it would of course be conclusive. (3) Carduus acanthoides, thought by some to be most like the stone thistles in the chapel at Holyrood; but it appears to me to differ in having spreading involucral scales and sessile globose heads. The leaves are not unlike. (4) Cnicus arvensis, the most common of all thistles near Edinburgh. This seems to me to be most like the stone thistles of Holyrood, as it agrees with them in having adpressed, involucral scales, and a long bare neck. (5) Cnicus lanceolatus, another very common thistle, does not suit at all, as it has spreading scales and winged stem.

I therefore vote for Cnicus arvensis; but I hope some other member of the Society will take up the matter, and give us his opinion, after comparing living thistles with the stone ones at Holyrood and Redford.

The thistle first appears on Scotch coinage on coins of James III.; but it is far more common after 1500, when "The Thistle and the Rose" was published—*i.e.*, on coins of James V. and Mary.

While the history of the rose as the badge of England can only be traced to the Wars of the Roses, and that of the thistle, as the badge of Scotland, to the time of the Stuarts, the date of the shamrock, as the badge of Ireland, can be traced to a much earlier period. The Apostle of Ireland, St Patricius, a native of Clydesdale, when preaching in Ireland early in the 5th century, explained the mystery of the Trinity by showing the people a blade of trefoil. After the whole nation had become Christian, the trefoil was adopted as the badge of Christian Ireland. Few missionaries have been so successful as St Patrick was, as during the three or four succeeding centuries Ireland became the centre of Christian teaching all over Western Europe. By Irish missionaries, Scotland, Northumberland, and great portions of Germany and Switzerland, were Christianised. By far the greatest monastery in all Switzerland, that of St Gall, was founded by an Irish Christian missionary.

But to return to botany, what was St Patrick's trefoil? and what is the plant now recognised by the Irish as their shamrock? There are three claimants — the wood-sorrel (*Oxalis acetosella*); the white clover (*Trifolium repens*); and the slender yellow trefoil (*Trifolium filiforme*). The wood-sorrel is called shamrock in many English books; but it is not a conspicuous plant till it flowers, and it does not flower till a good while after the 17th March, or "St Patrick's Day." In Irish and Gaelic dictionaries, shamrock is always translated "clover." I ought perhaps to mention that the word shamrock does not mean "three leaves" in Gaelic, as some books state; nor, as other books state, is shamrock the Arabic for three leaves. Even if it were, why should the Irish have borrowed an Arabic name for a common plant? Shamrock simply means "clover." As to which kind of clover is really the true shamrock, a census was lately taken by writing to numerous persons in each county in Ireland. About two-thirds of the counties voted for Trifolium filiforme, and one-third for Trifolium repens. Our secretary, Mr Moffat, however, informs me that Trifolium repens was lately sent him from Cork as shamrock.

On the whole, I would vote with the majority of Irishmen for Trifolium filiforme, with which should be combined the two other yellow-flowering trefoils, Trifolium procumbens and T. minus. The only other competitor I know is water-cress (*Nasturtium officinale*), which is called shamrock in Hollinshed's 'Chronicle,' 1556,—but this seems absurd.

In the Museum of Science and Art there is a beautiful stone carving of the rose, thistle, and shamrock, by an Italian artist. Unfortunately it is combined with the lily of Florence, not with the leek of Wales.

If the thistle and the rose are comparatively modern, and the shamrock not very ancient, we find a different state of things with regard to the leek of Wales. The veneration for the leek goes back to the very dawn of history. The children of Israel mourned in the wilderness that they had no leeks to eat. Slavery with leeks was better than freedom without. In Book X. of the 'Odyssey,' the enchantress, Circe, changed the followers of Ulysses into pigs by giving them a drug, Mandragora officinalis—a stemless kind of Belladona; but the hero himself remained unaffected by the poison, because he had concealed in the folds of his dress the sacred plant, the leek, which Homer tells us the gods call "moly."

The origin of the belief in leeks is twofold. (1) In early times vegetables were scarce. Primitive men lived on flesh, fish, or shellfish. The leek was the first vegetable cultivated, and was therefore highly valued. (2) Primitive man had also a horror of the wilderness, and a love of the cluster of huts, where alone he was safe from wild beasts. The edible leek was adopted as the type of the little hamlet, with its patch of ground where pot-herbs grew. The poisonous mandrake is the type of the wilderness, where dwelt savage beasts, the enemies of man (see Gen. xxx. 14). Mr John S. Glennie informs me that even in the present day boys in Greece often wear bits of leek in their caps, to avert bad luck; and that a similar effect is obtained by pronouncing the word "skorodon," or leek.

No races can be more unlike than the two Celtic nations of Britain—the Welsh with their leeks, the Irish with their shamrock: the one sedate, reticent, retiring; the other reckless, fickle, enterprising. They are as unlike as were the Dorians and Ionians of ancient Greece. From their favourite letters, Professor Rhys has called the Welsh the P Celts, and the Irish and Highlanders the Q Celts; so the Dorians might be called the P Greeks, and the Ionians the Q Greeks.

In conclusion, if one botanical species is to be taken as the emblem of each one of the four nations, I would select Rosa arvensis for England, Cnicus arvensis for Scotland, Trifolium filiforme for Ireland, and Allium porrum for Wales. You will notice that the English and the Scotch have adopted thorny, spiny plants, suitable to their hard, angular characters; whereas the poetical Irish have chosen the graceful trefoil, with its early Christian associations, and the Welsh have selected a plant useful rather than beautiful, as if their aspirations were after domestic peace and plenty. It is the same in heraldry. The strife-loving English and Scotch are represented by the leopard and the lion, and the music-loving Irish by the harp. Nor is this all. We see the same idea carried out even in their choice of colours, where we have to contrast "England's cruel red" with the tender green of the peace-loving Emerald Isle.

At this meeting Mrs Carphin read a paper on "British Land and Fresh-water Shells, and where to find them," and exhibited a number of specimens.

II.—*A VISIT TO INGLETON.*

By Mrs SPRAGUE.

(*Read Dec. 28, 1893.*)

Many years ago an old college friend recommended my husband to visit Ingleborough, in the West Riding of Yorkshire, and we were at last led to decide upon doing so by the appearance in the 'Graphic' in October 1885 of a number of views of the caves and waterfalls near the village of Ingleton, and of the mountain "Ingleborough". In August 1886 we left Edinburgh by the morning train, reaching Ingleton in the afternoon; and we at once took up our quarters at the Ingleborough Hotel, in the centre of the little town. Next day we visited the famous Clapham Cave, four miles from Ingleton. Clapham village is a lovely spot, with its river overshadowed by fine trees, and its white cottages and gardens brilliant with flowers.

The cave is situated in the Rev. Mr Farrer's grounds, and the guide appointed by him led us through the park and past the artificial lake, to the entrance of the cave. Here there is a barred iron gate, which is kept locked on account of the damage done by excursionists formerly, when the cave was free to all, by breaking off the stalactites and stalagmites. Each of us was provided with a candle fixed on to a piece of wood, and we followed the guide in single file down a long and tolerably wide passage. A small stream runs through the cave, and in some parts there are pools some 4 or 5 feet deep, across which planks are laid. In another part of the passage the ground is rocky and uneven, and the path very narrow and slippery. Here an iron rail is fixed to the wall, without which there would be much risk of falling. In another part we had a laughable adventure. The flat roof of rock is so low that it is necessary to proceed in a crouching attitude, and it slopes down to the right until it is not more than 2 feet from the rocky floor. One of our party got nervous and confused, and when we called out, "Keep to the left!" she kept moving farther and farther to the right, and presently got wedged in for a time; and when we at last succeeded in making her understand that she was going in the wrong direction, she laughed so immoderately that she was wellnigh helpless to extricate herself. On our return journey this passage was much easier, as the rocky roof sloped upwards towards the entrance, and we came gaily through at a run in a doubled-up attitude.

The stalactites are wonderful in this cave, many of them simulating the form of various articles, such as a beehive, a jockey's cap, a large ornamental chandelier, a flitch of bacon, a French bed with canopy, a large white pillow, an immense bride's-cake covered with glittering icing, &c.; and some graceful stalactites hung like the folds of a tablecloth. These, when gently struck with the guide's stick, gave out sounds like soft church bells. Unfortunately, some of these had been broken by tourists, so that many of the notes were spoilt. One little stalactite is called "The rasher of bacon", from its shape; and when a candle is held behind it the streaky appearance of "fat and lean" is very exact.

There are also many stalagmites, formed by the dropping of water from the roof. Some of these were curiously shaped like Indian idols. In some places the stalactites and stalagmites meet, and form slender pillars between the roof and floor of the cave. Our guide was very amusing and talkative about the "mites" and "tites", as he termed the stalagmites and stalactites. He told us that the late Mr Farrer explored one of the holes, at the extreme end of the cave; as water was heard flowing below, and he suspected there was another cave. Having, with his gardener, made his way down the hole, they were presently stopped by a deep pool of water. Mr Farrer fixed a candle to his cap, and a rope round his body (the end of which was held by the gardener), and swam across the dark lake, but found on the other side an impassable wall of limestone. This wall, we were told, was to be bored, and it was hoped that a passage would thus be made into another cave, so that it would be possible to proceed to the other side of the mountain "Ingleborough".

The next day we visited Weathercote cave. This is quite different from Clapham cave. A pleasant drive of four miles past Chapel-le-Dale (said to be the smallest church in England) brought us to the cave. It is walled in, but a guide is at hand to show the cave on payment of a small fee. The cave consists of two holes or caverns, separated by an enormous stone which forms a natural arch. All around are dark rocks, overgrown with ivy, ferns, and mosses; and underneath are rough blocks of stone. You go through the first cavern, and come in sight of the fall within the second. It is necessary to walk cautiously here, for the rocks are as slippery as glass. One of our party fell, knocking down three others; but happily a few bruises were the only results.

By scrambling down some ten feet farther, the foot of the waterfall is reached. The water, after its fall of 75 feet, disappears under ground for about a mile, and then appears again as the little river Doe, or Dale Beck, which flows down the Beezley Falls and joins the river Greta at Ingleton. The visitor can stand behind the fall, if he does not object to a shower-bath while making his way there.

After leaving Weathercote cave, we proceeded to Gingle Pot, a curious vertical chasm in the ground, which is 90 feet long, $10\frac{1}{2}$ feet wide, and 54 feet deep. The name is given to it in consequence of the jingling sound made by stones thrown in. In winter and in time of floods the rush of water is so great, that huge stones are thrown up, and left on the edge of the chasm. Our guide showed us a huge piece of rock thrown up thus.

As we wished to make the most of our week at Ingleton, we used, after our long excursions in the morning, to walk in the afternoon and evening, to the various places of interest near at hand. In this way we visited the Beezley Falls, an interesting series of cataracts. These are reached by passing through Baxengill gorge, which is overhung with trees, and is considered one of the most impressive pieces of scenery in this locality. Here caution is necessary, as the paths are narrow and slippery in places, and accidents have happened. Especially in following the path round the old slate quarry the visitor should keep as far from the edge as possible, as the loose slates are treacherous.

Another charming walk is through Swillabottom to the Pecca Falls and Thornton Force. Thanks to the Ingleton Improvement Association, good paths have been formed, and seats placed at short distances. Here the visitor can rest after climbing some of the steep paths, and admire the exquisite views that meet his eye, of waterfall, deep dark pool, and glittering river, frowning precipice, and graceful trees, ferns, and flowers. The Pecca Falls range from 5 to 20 feet in height, and immediately after heavy rains, when the water rushes in great volume down the glen, there are eight falls. Ordinarily there are four or five. After passing a huge rock in mid-stream called Cuckoo Island, in about a quarter of a mile or less we reach Thornton Force, a fall of about 30 feet. At the left of the Force a thin spray of water rushes out of the centre of the face of the rock. Thornton Force flows through a naturally worn aperture in the rock, about 20 feet deep. This fall is more open to view, and safer for sightseers, than the Pecca Falls.

About 200 yards beyond Thornton Force is a wild rocky pass, named Raven Ray. This we unfortunately were unable to see, for lack of time. One of our evening walks was to Easgill, a very pretty little fall situated in a lovely little ravine, about a mile from Ingleton. To reach it you pass through a gate opposite the farmhouse of Yarlsber, near to a supposed Roman camp. A little brook flows through the ravine, which is shaded by trees and shrubs, while ferns and wild-flowers grow on the rocky banks; and I noticed a number of the little green rosettes of Primula farinosa amongst them. The path up to the Fairy Fall, spanned by a natural arch of rock, was muddy and slippery when we went, as the evening was wet.

A charge of one penny for each person is made by the owners of the farmhouse, for permission to pass through their field to reach the fall; a fee which no one would begrudge for the pleasure received in lovely little Easgill. Another farmhouse not far from Yarlsber, bears the name of Slatinber; both being near the site of the supposed Roman camp. According to the guide-book, these two names seem to point to the existence there, at some time, of earthworks or fortifications.

Yordas cave is well worth a visit. It is a pleasant drive of four miles from Ingleton. According to tradition, "Yordas" is the name of a giant who once lived in the cave, which is a dark gloomy cavern in Kingsdale, and penetrates the base of Gragreth or Dent Crag, 2250 feet in height. Yordas cave contains a great chamber 50 or 60 yards long, about 20 yards high, and 15 yards broad. At the end of this vaulted chamber is another large cavern, and a conically shaped hollow containing a waterfall. We compared it to a small side chapel in a cathedral, with a waterfall inside! We realized when in Yordas cave, what "pitch darkness" was; for our few small candles only seemed to serve to make the darkness visible. There are some curious stalactites here. One is like a polar bear, coming down the rock; another resembled the Gothic wood-carving often seen over the bishop's throne in a cathedral; another was like the pipes of an organ. A stream enters the cavern on one side, flows through it, and disappears on the other side. The high roof caused our voices to resound in a curious way as we all sang the "Old Hundredth". The scene and sounds were very impressive. Shut in by the huge cavern's dark walls, with the inky stream at our feet, the feeble glimmer of our candles almost increasing the gloom, and knowing that we were deep in the bowels of the earth, far from sight or sound of our fellow-creatures, we could not help thinking, what if our lights were to go out? Would the guide be able to find his way back to the entrance?

On our way back from Yordas cave we climbed a hill, in order to view a "pot" or chasm in the ground called Gingling Pot. This is somewhat similar to Gingle Pot already described, but is larger and rather more curious, being at the top of one of the fells. It has been measured to a depth of 150 feet without the bottom being reached. Not far from this we found two small pots connected with each other by a short passage through the limestone rocks, through which we managed to crawl. Many pretty plants grow in the crevices of these limestone scars, such as Geranium sanguineum, Hart's-tongue and other ferns. The rare Cypripedium calceolum and the Fly orchis are occasionally found in Baxengill gorge. Another day we visited the quaint and pretty town of Kirkby Lonsdale, and the lovely little village of Casterton, which is seven miles from Ingleton.

We also made the ascent of "Ingleborough", 2373 feet in altitude. The top is flat, and about a mile in circumference. Apparently at one time there was a wall round the whole or greater part of the summit. The remains of nineteen huts are on the top. On a clear day a fine view is obtained, and Tarleton Knot, Wharton Crag, and Morecambe Bay, the various mountains in the Lake district, Lancaster, Fleetwood, and occasionally the Welsh hills and the Isle of Man, may be seen. We noticed some curious "pots," or circular holes, on coming down the mountain. In one of these was a small waterfall, which disappeared underground beneath a huge boulder. This "pot" was overhung with bilberries, delicate ferns, sprays of honeysuckle, and the beautiful Rose-bay (*Epilobium angustifolium*), being quite a picture in itself. It was perhaps 35 feet deep, and 12 or 14 feet in diameter.

On leaving "Ingleborough" we passed the White Scars, a remarkable limestone formation, jutting out like a promontory, the point of which is 1354 feet above the sea-level. The top is flat, like a level platform, being remarkably even, and is a sort of grand natural colossal pavement well worth seeing.

In conclusion, I may mention that our party included five children, the youngest of whom was only six years of age. This will indicate that all the charming walks we took are well within the powers of ordinary walkers; and I shall be very glad if this short record of a week's rambles at Ingleton, should lead others to visit the place.

III.—*THE INTERIOR OF THE EARTH.**

By Mr T. CUTHBERT DAY, F.C.S.

(*Read Dec. 28, 1893.*)

From the earliest times the nature of the interior of the earth has been an object of mystery and speculation to mankind. The ancients of Greece and Rome placed there the future abode of souls after death, the good inhabiting the Elysian fields, while the bad were relegated to the abysses of Tartarus, the supposed home of desolation and punishment. Even after the death of paganism many Christian believers have referred the locality of hell to the same mysterious and awe-inspiring place, which is generally connected in the human mind with the idea of unquenchable fire. In the Northern mythology the interior was supposed to be inhabited by a singular race of beings, the dwarfs, and we have a picture of their operations underground in the old legend which describes the journey of Skyrnir, the companion or servant of the summer god Frey, to these regions, whither he was sent in order to obtain from the dwarfs the slender but unbreakable chain with which Odin and the rest of the gods intended to bind the savage wolf-giant Fenrir. There he sees these wonderful little people, some leading up veins of precious metal, where they will one day meet the eye of man; others fashioning rubies, diamonds, and other precious stones; and still deeper down he finds the swarthy shrivelled race whose business it was to feed with fuel the earth's great central fire.

To-night we have not to deal with these crude speculations and beliefs; but I shall endeavour to lay before you, briefly, the state of our knowledge, at the present time, with regard to the material and physical nature of the interior of the globe.

The earth, as everybody knows, is a globe, having the figure of an oblate spheroid. The equatorial diameter measures 7925·6 miles and the polar diameter 7899·1 miles, which gives a difference in favour of the equatorial diameter of 26·5 miles. It is supposed by some that this flattening of the

* Compiled from data found in Prof. Jukes Browne's 'Physical Geology,' and other sources.

poles was caused by the revolution of the earth on its axis when in a plastic condition, due to its high temperature at the time. We have no direct evidence to prove that it ever was so, though mathematicians think that the fact of the earth having this particular shape is strong presumptive evidence of a former plastic state. I believe physicists and men of science generally assume that the earth was once in a molten condition throughout, and that its present state as regards temperature is due to cooling by radiation during long ages. The solid crust which has formed in the meantime, and which we inhabit, effectually cuts off from our observation whatever may be happening in the depths below. Still, certain scraps of evidence in different forms are afforded us, which, if interpreted aright, may help us to divine in some degree the state of affairs underground.

I think we may conveniently divide the inquiry into three parts,—1st, What is the temperature? 2d, What is the condition? 3d, What are the materials, in the interior of the globe?

1st, as to temperature. From the existence of volcanoes in every quarter of the globe pouring out volumes of molten lava and hurling fragments of incandescent rock a great height, while the clouds above reflect far and wide the light from the glowing furnace of their open craters, we cannot doubt that some part of the interior must be at a very high heat indeed, sufficient at least to render refractory rocks perfectly fluid. We are equally sure that these manifestations of high temperature, so near the surface, are very local. Measurements of the heat in deep mines and borings all point to the conclusion that we must go far deeper than we have ever yet been, before we meet with anything like the degree of heat commonly exhibited at active volcanic centres.

The influence of the changes of temperature brought about by climate does not penetrate very far into the earth's crust, and it has been estimated that at a depth of about 50 feet beneath any given place on the land a thermometer would mark the same temperature all the year round. This point is called the "limit of seasonal variation." Below this point, as far as we have been able to pierce, it is found that the temperature of the rocks always increases with the depth. This increase varies in different places—in great part, no doubt, owing to differences in the conducting capacity for heat of the different kinds of rocks. This fact may account for variations in the increase of temperature in the same boring.

In the mines of Cornwall and Devon, Mr Henwood made a number of observations of temperature at various depths. They were among the first experiments of the kind. The average result in 200 of these mines gives the following figures:—

Depth.	Temperature.
200 feet	About 57° Fahr.
600 "	" 62° "
900 "	" 68° "
1200 "	" 78° "

The average increase below 300 feet being about 1° F. for every 43 feet of descent.

In Rose Bridge Colliery, near Wigan, where a shaft was carried down to a depth of 2445 feet, Mr Brigham, the manager, made a careful series of temperature observations during the process of sinking. The heat at the lowest point was found to be 94° F. These observations showed an average increment of 1° F. for every 55 feet of depth. The actual heats obtained were as follows:—

Depth.	Temperature.
564 feet	66° Fahr.
1674 "	78° "
2013 "	86° "
2445 "	94° "

While, then, there appears to be some variation in the rate of this increase at different points, it is an undoubted fact that the temperature of the rocks does always increase after passing below the first 50 feet; and it seems that the average rate of this increase of temperature may be taken at about 1° F. for every 51 feet of depth.

The heat of water in deep wells and borings at the bottom is in agreement with the above conclusion. The water which flows from the artesian well of Grenelle, near Paris, and which rises from a depth of 1800 feet, has a constant temperature of 82° F., which is about 31° hotter than the mean temperature of the ground beneath Paris. This indicates a rate of increase of 1° for every 58 feet of depth. Another well near Paris, at La Chapelle, where observations were taken at different depths, gave the following results:—

Depth.	Temperature.
330 feet	$59\frac{1}{2}$° Fahr.
660 "	62° "
1000 "	$65\frac{1}{2}$° "
2200 "	76° "

These figures give a slower rate of increase—viz., only 1° F. for every 82 feet.

At Sperenberg, near Berlin, a boring was made to a depth of 4172 feet, nearly all through rock-salt, and the temperature observed at a depth of 4042 feet, when corrected for pressure, gave a result of 1° F. for every $51\frac{1}{2}$ feet.

In considering the evidence afforded by geysers and hot springs as to internal heat, those which occur in the neighbourhood of volcanic centres must be regarded as deriving their heat from proximity to the locally heated rocks, which of course may not be at any great depth.

Warm springs at a distance from volcanoes, such as those of Bath or Buxton, appear to rise through fissures of great depth in the crust, and may owe their comparatively high temperature merely to the distance underground of their origin; and they must probably lose a considerable portion of their initial heat by parting with it to the rocks they traverse on their way to the surface.

From all the foregoing considerations it is plain that the farther we pierce into the crust of the earth the hotter it becomes; and, starting with this fact, we are more in a position to consider, by inference, the probable condition of the earth at very great depths, and this brings us to the second head in our inquiry. To solve the problem now before us the aid of mathematics has been largely employed, based on deductions from physical experiments, and also from astronomical observations. The value of such inferences in an undertaking of this nature is largely discounted by our total want of knowledge of the behaviour of matter under the influence of the enormous pressure to which it must be subjected in deep-seated regions of the earth.

If we assume that the rate of increase in temperature of 1° for every 51 feet is maintained, on arriving at a depth of a little under 2 miles the rocks would be as hot as boiling water; at a depth of 27 miles the temperature would be as high as 2794° F., which would be sufficient to melt steel; and at 40 miles, which is really only a little way down, we should have a temperature higher than any we could produce at the surface.

It is highly probable that at these great depths the materials, though at an intense heat, are not in a state of fusion, but are more or less pasty or even solid, owing to the enormous superincumbent pressure. It is well known, in the case of many solid substances with which we are acquainted, that pressure has the effect of raising the melting-point to a small extent. The direct effect of pressure on the fusing-point of rock has yet, I believe, to be studied, and it is likely that different ratios would be found for different materials.

It has been supposed that the ratios of pressure and temperature within the earth are such, that below a certain depth the pressure is only just sufficient to prevent the liquefaction of the rocks by the temperature proper to that depth, so that any local cause diminishing the pressure would allow of liquefaction.

Again, it is possible that the ratios of the increase of pressure and temperature are such that, at a certain depth, the pressure is insufficient to prevent liquefaction at all, and consequently, that a certain thickness of the earth's mass is liquid; but that, at a still greater depth, the increased pressure overcomes the influence of heat, and keeps the rocks solid in spite of increased temperature. It is also possible that beyond a certain depth, which perhaps may not be so very great, there is no further rise in temperature.

Whether the interior be to a great extent fluid or solid, we may safely admit that it has a very high temperature, and in that case it must be continually parting with it by radiation. The cooling has proceeded so far now that the heat, if any, passing into space through the outer crust at the present time is so small in amount that it does not appreciably affect the zone which lies above the depth of 50 feet from the surface, the "limit of seasonal variation."

By these considerations we are led to the conclusion that if this radiation into space has gone on for untold ages, there must have been a time when the earth was in a molten state throughout.

Assuming this to be the case, the condition of the earth's interior at the present time must depend on the manner in which it has cooled, and Mr Hopkins has shown that the earth's mass must now be in one of three states: these are—

1. A solid crust with a fluid interior.
2. A solid crust and a solid nucleus with a fluid inter-stratum.
3. A solid throughout, with or without fluid spaces or cavities

Hopkins concluded that the balance of probability was in favour of No. 3. He bases his argument on astronomical reasoning. Sir W. Thomson agrees with Mr Hopkins's conclusion that the earth is either solid or possesses so thick a crust that it amounts to the same thing. He thinks that the tide-producing power of the sun and moon is so great that unless the thickness of the crust exceeds 2000 miles it would yield to the strain. Sir W. Thomson finally concludes that the mass of the earth "is on the whole more rigid than a continuous globe of solid glass of the same diameter."

Professor G. H. Darwin investigated this problem twice,—first in 1879, when he concluded that the rigidity of the earth was not so great as Thomson supposed, but at the same time he stated "that no very considerable portion of the interior can even distantly approach the fluid condition." In his second investigation of this extremely complex subject, he expresses his result as generally confirmatory of Thomson's view as to the effective rigidity of the earth's whole mass.

Mr Fisher, in his 'Physics of the Earth's Crust,' suggests the existence of a fluid substratum which does not consist entirely of melted rock, but of a mixture of melted rock with dissolved gases, such as water, vapour, hydrogen, &c. This supposition is said to meet the requirements of astronomers, and has a certain amount of evidence to support it. Large volumes of steam and hydrogen are frequently observed to be evolved from active volcanoes, which may be considered to have some connection with the fluid substratum.

This theory of a fluid zone in the earth's crust, if sound, is of great importance to geologists, who would otherwise have some difficulty in accounting for many geological facts connected with earth movements if the globe were considered to be rigid throughout. Assuming the existence of the fluid substratum, Mr Fisher, from physical considerations, assigns an average thickness of 25 miles to the outer crust at the sea-level, and that it is thicker under mountain-chains and thinner under the oceans.

The conclusions to be drawn from a survey of all the foregoing observations regarding the state of the interior of the earth may be stated provisionally as follows: 1st, That the interior is very hot. 2d, That a portion of it is liquid, and forms a continuous layer between the solid crust and the central mass, whether that be solid or plastic. 3d, That the solid crust is comparatively thin. 4th, That the liquid layer is saturated with dissolved gases.

With regard to the third point of our inquiry—namely, the nature of the materials composing the interior of the globe—it is well to realise at the outset what a very short distance we have been able to pierce the crust by means of mines or boring: a mile is beyond the greatest depth so reached, and this is less than the $\frac{1}{4000}$ part of the distance to the centre. Fortunately, we have two means of observing the nature of substances from great depths—first, by means of matter ejected or poured out by volcanoes; and secondly, in the character of the plutonic rocks, underlying or injected among stratified rocks, and laid bare by detrition of the superincumbent strata.

The most important evidence of the nature of materials from the interior is furnished by astronomical data. It is found that the average density of the matter forming the whole earth is about $5\frac{1}{2}$ times that of an equal bulk of water. This is not mere conjecture, but may be considered as proved beyond controversy. Now the mean density of the substances composing the crust, as far as our greatest range of observation extends, varies from $2\frac{1}{3}$ to 3 times that of water. On these grounds, we are forced to the conclusion that at very great depths indeed the materials are of much greater density than at the surface; and it seems that that density must be at least twice as great. It is difficult to say to what extent matter may yield to compression at such great depths and under tremendous pressure; but from our present knowledge of the behaviour of different substances when subjected to great squeezing force, we may pretty safely assume that beyond a certain rather small shrinkage, matter will not further yield to additional pressure. Putting aside, then, the possibility of unlimited compressibility, we must infer that the interior portions of the globe are composed of materials of a *different kind* to those appearing at the surface.

Careful study of the substances brought up through volcanic vents shows that even at moderate depths there exist materials differing widely in density and chemical composition. The lightest lavas have a density of 2·3, and the heaviest of over 3. We have also the clearest proof that materials of even greater density are brought to the surface by volcanic agency.

Here, again, the study of astronomy and the results of spectrum analysis in recent years afford us valuable help. We know that the earth is one of a family of globes revolving round the sun as a centre, and that they have a close relationship with one another. As far as spectrum analysis has been applied, we have every reason to believe that not only the members of the solar system, but the more distant bodies of the universe, are all composed of the very same elementary substances as those which enter into the composition of our earth.

Until within quite recent times the space occupied by the members of the solar system was generally considered to be a great void. We now know that the interplanetary space simply swarms with small bodies, all travelling in definite paths under fixed laws, and acting and reacting on one another, sometimes coming into collision. Now and then some of these small bodies, meteorites as they are usually called, find their way to the earth, and from a study of their composition we derive the best evidence we have of the composition of the planetary bodies outside our earth.

No chemical element has been found in any meteorite yet examined which is not also found on the earth, and out of the 70 odd elements known to science I believe 22 have been detected at various times in different specimens of meteorites.

Though the number of elementary substances is so large, we may take a dozen as occurring in conspicuously large proportion in the earth's crust, the remainder forming a relatively insignificant part. The twelve elements are oxygen, silicon, aluminium, calcium, magnesium, sodium, potassium, iron, carbon, hydrogen, sulphur, and chlorine.

The rocks forming the earth's crust are composed half of oxygen and one-fourth of silicon—that is to say, they are mostly made up of silica or silicates in one form or another. In meteorites, though these compounds are present, they are usually in very small proportion, and the bulk of meteorites is generally metallic, the predominating metal being iron. Many of the meteorites containing some amount of stony material have been found to yield minerals identical with many which occur in rocks of the earth found at great depths or brought up by volcanic agency—namely, olivine, enstatite, augite, anorthite, magnetite, &c. The minerals thus found in meteorites always resemble those which occur in the more basic volcanic rocks. Quartz, acid felspars, and other minerals which occur in acid rocks are never met with in these bodies of extra-terrestrial origin. Among volcanic products rocks and lavas called *ultra-basic* are met with in comparatively rare instances, but a remarkable fact about them is that they are almost entirely made of minerals of precisely the same character as those found in the stony portions of meteorites. The Picrites are an example of the ultra-basic volcanic rocks, and I believe an exposure of this rock is still to be seen in the new Barnton railway cutting, if it has not by this time been "dressed" out of sight by the workmen. The specific gravity of these ultra-basic rocks is high, usually above 3, and they contain a low percentage of silica and a comparatively high one of magnesia and iron. Recently a most interesting discovery was made, namely, that materials very closely resembling the metallic portions of meteorites are sometimes brought to the surface by volcanic means. In the year 1870 Nordenskiöld found at Ovifak, on the south side of the island of Disko, off the coast of Greenland, a number of blocks of iron which agreed in composition with ordinary metallic meteorites, as was seen on a chemical examination of specimens. It was at first supposed that a lot of meteorites had here curiously fallen at one spot. A detailed examination of the district by Professor Steenstrup led him to the conclusion that the masses of iron were not of meteoric origin at all. This part of Western Greenland, in Miocene times, was the focus of very intense volcanic activity, and near the spot where the iron masses occur there are found numerous basaltic dykes, which, when closely examined, were found to be full of particles of metallic iron. The matter has been carefully gone into by other authorities, and the conclusion arrived at is that the large iron masses of Ovifak, as well as the particles diffused through the basalts, are of terrestrial origin, and have been brought up from the interior of the earth by volcanic agency. It is supposed that by the weathering away of the basalts the large blocks of iron have been liberated from their matrix, and were left exposed in the position where they are found. It is probable that, just as we find in many basaltic lavas nodules of ultra-basic materials similar to the stony portion of meteorites, so in these basalts of Ovifak we have masses of iron alloyed with nickel, &c., similar to the metallic portions of meteorites. Both the stony and the metallic enclosures in the basalts are in all likelihood derived from deeper portions of the earth's crust.

Other facts go to support this conclusion. Professor Andrews has shown that certain basalts in our own islands contain microscopic particles of iron. Further evidence is furnished by the occurrence of mineral veins proper. In these veins, which are supposed to communicate with the interior by deep fissures, the native metals and their alloys are found, also their compounds with sulphur, chlorine, phosphorus, &c.; but their oxides, except as products of subsequent alteration, occur far less frequently than in the earth's crust generally.

Putting all these scraps of evidence together, and bearing in mind the demonstrated fact that the materials composing the interior are of much greater density than those at the surface or composing the higher portion of the crust, we may fairly conclude that those materials which we see at the surface for the most part combined with oxygen, are at very great depths found in their free or uncombined state, and that among them metallic substances, especially iron, play an important part. To conclude with a rough illustration, our earth may be compared to a cannon-ball which has been exposed to the weather for a number of years: the surface or crust is entirely composed of oxide of iron, while the interior still preserves its metallic character; and our endeavours to pierce the crust of the earth may be likened to the scratch of a pin on the coating of rust which surrounds the cannon-ball.

Of all the problems relating to the interior of the earth, that one respecting the physical condition is the most obscure. New theories and conjectures are in the air, and perhaps before long some one with an unusually keen insight in matters of this sort may propound a solution of the difficulty which will agree better with observed facts than any yet suggested.

At the evening meeting of January 25, 1894, Emeritus Professor Struthers delivered an address on the subject of "Evidence of the Descent of the Horse of the present day from a many-toed Ancestor." The address was illustrated by a number of diagrams.

IV.—*SOME RECENT RESEARCHES ON GRAFTING, AND THEIR BEARING.*

By Mr WM. C. CRAWFORD, M.A.

(*Read Feb. 22, 1894.*)

The paper gave an account of the elaborate researches on grafting conducted during many years by Professor Vöchting of Tübingen, and recently published by him—'Ueber Transplantation am Pflanzenkörper,' 1892. It was illustrated by numerous lantern slides.

V.—*ON A BIFID EARTHWORM.*

By Mr J. T. MACK.

(*Read April 26, 1894.*)

The specimen of earthworm (*Lumbricus terrestris*) exhibited was found by a friend of mine, Mr J. A. Thomson, Blackford, Perthshire, while digging in his garden a year or two ago. It has been dissected by Mr H. C. Williamson, M.A., B.Sc., St Andrews Marine Laboratory, to whom it was handed by Professor M'Intosh, St Andrews. Mr Williamson says:—

The specimen is an earthworm in which the posterior half of the body is double. Each of the posterior portions has an anus. The recorded cases of bifurcation in the species of Lumbricus are few in number; and while that abnormality has been noticed not unfrequently in Polychæta, still comparatively few have been described. Professor E. A. Andrews, of Baltimore, U.S.A., published a list of the references made by different authors to bifurcation in Annelids in 'Nature,' vol. xlvii., No. 1214, Feb. 2, 1893. . . . It is probable that this earthworm existed as a normal Lumbricus, before the right-hand appendage was developed. The cause of the budding must be left undecided. There is doubtless some connection between the fact that the reproductive organs are so undeveloped and the presence of the lateral bud. Whether the reproductive organs were from the first undeveloped, and the bud represents an attempt at asexual reproduction, or the reproductive organs atrophied in later life owing to the budding process, can only be a matter for conjecture. An interesting question suggests itself,—How did this worm manage to move through the earth? It was alive when dug up. It would have no difficulty in moving about on the surface, but it certainly could not have readily burrowed in the ground. It therefore probably lived on the surface or amongst soft soil and decaying vegetable-matter close to the surface.[1]

Mr Williamson, it will be noticed above, raises the question as to how this worm managed to move through the earth, and he assumes that it existed either on the surface or close to it. Mr Thomson assures me, however, that it was at least one foot beneath the surface when dug up.

[1] 'Annals and Magazine of Natural History' for March 1894,—which see for other examples of bifurcation in the species of Lumbricus.

VI.—*DAVID DOUGLAS.*

BY MR THOMAS WRIGHT.

(*Read April 26, 1894.*)

As eleven years have rolled by since David Douglas went over to the majority, it may seem rather late in the day to write an obituary notice. Yet, with your permission, I should like to place one stone on the cairn that marks his unvisited grave.

Douglas was a south-country man,—one who

> "Was reared among the hills
> Within a Border home."

His early manhood was spent in Leith, where he toiled as a hammerman, but afterwards he obtained more congenial employment as attendant in the Museum of Science and Art. Unfortunately he was afflicted with a painful disease, which surgical treatment failed to relieve, and he died in the Royal Infirmary while yet in his prime.

Those who were in the habit of frequenting the Museum in the seventies will cherish kindly memories of David Douglas. He was a canny Scot,—modest and unassuming; somewhat reticent, perhaps, and slow to make acquaintance, but to those who gained his friendship he proved himself a man of sturdy integrity. Notwithstanding the lack of early education, he did excellent work as a naturalist. His contributions to the pages of 'Science Gossip' give ample evidence of rare ability as an observer, and of sound judgment in the interpretation of carefully ascertained facts. Botany was his chief study. So well was Douglas acquainted with his Flora that he seldom required to consult the index, and could honestly quote, in this connection, Dante's address to Virgil,—

> "I long with zeal
> Have sought thy volume, and with love immense
> Have conn'd it over."

Birds also occupied a share of his attention. Latterly he worked hard at the British Coleoptera. So far as I have been able to gather, his published work consisted of Notes on the following subjects: "Strange Plants gathered at Leith;" "The Falcon;" "The Whale;" "Plantago lanceolata;" and "Anacharis alsinastrum."

The Herbarium collected by Douglas bears testimony to his accomplishments in botanical science. He had commenced gathering plants in the woods near Makerstoun in Roxburgh during 1859, when a lad of fourteen. His diligence seems never to have abated; but judging by the large number of preparations made in '76 and '77, he must have worked at high-pressure during these years. Leaving out of account the Mosses (now in the possession of one of our members, Mr Mark King, who was an intimate friend), Douglas's cabinet contained 1345 specimens, mounted with scrupulous care, accurately named and numbered in accordance with the seventh edition of the 'London Catalogue.' This fine set of dried plants was presented to Mr Brotherston, a gentleman who had studied Entomology, and intended to devote his leisure time to Botany. But the pressure of business, and other pursuits, hindered the fulfilment of Mr Brotherston's intentions in this matter, and thinking it a pity that the collection should lie unused in a lumber-room, he generously handed over to me the entire Herbarium.

In the month of November 1880 David Douglas contributed to 'Science Gossip' a note on the Water Thyme (*Anacharis alsinastrum*). In that article he mentions the various points that make this aquatic plant an attractive study to botanists. It is an immigrant from America, and thrives better in the land of its adoption than in its native rivers. It is of interest to the physiologist, as it shows peculiarly well under the microscope the circulation of the protoplasm. Although the Water Thyme had been known to botanists for forty years, Douglas was the first who discovered the male flowers in Britain. He found them in a pond on the Braid Hills early in August 1880. In subsequent years male flowers were collected in the same pond by Mr Kinnear, a former member of this Society. As a natural result of this discovery, Douglas received applications for specimens from collectors in various parts of the country—among others, from the Professor of Botany at Cambridge. But a prophet has no honour in his own country. One is rather disappointed to read in the new edition of 'Chambers's Encyclopædia" (1888) that "British specimens of Anacharis are exclusively female, the male plant not having been introduced." I wrote to the editor, Dr Patrick, calling attention to this inaccuracy, and he has courteously promised to make the correction in the next edition. I trust the name of the discoverer will also be mentioned, and some recognition be thus made of a worthy Scottish naturalist.

EXHIBITS IN NATURAL HISTORY.

THE following were the chief exhibits at the evening meetings throughout the session:—

BY MRS SPRAGUE.

Wasp's Nest from Africa.—This nest is of a roughly cylindrical shape, 7 inches in length, and 4 inches in diameter. It is formed of a sort of papier-maché, of a pale brownish colour, and was suspended from a small branch of a tree. The bottom is flat and circular, and the entrance to the nest is a round hole in the centre of the bottom. It was bought at a bazaar, and has two words written on it which seem to be "Cabas Tapinas". Nothing could be learnt about it at the Edinburgh Museum of Science and Art.

Land-shells from Mentone.—These included shells of the large edible snail, *Helix pomatia,* and the pretty *Cyclostoma elegans.* The most remarkable, however, was *Bulimus decollatus,* of which every specimen found was broken off at the apex. Regarding this condition of the shell, Professor Nicholson writes in his 'Manual of Zoology' (p. 353 of fifth edition): "In many of the spiral univalves, as the animal grows, it withdraws itself from the upper portion of the shell, often partitioning off the space thus left vacant. In many instances the portion thus abandoned falls off, and the shell becomes 'truncated' or 'decollated'; this being the normal condition in fully-grown examples of some shells".

Tropical Bean-pod (*Afzelia Guanzensis* (Welw.))—The pod exhibited was about 5 inches long by 2¼ broad. It contained five large smooth beans of a dull black colour, with a beautiful large scarlet aril. Another specimen was 6 inches long by 2 broad. A description of the plant is given in Oliver's 'Tropical Africa'.

Articles from Zululand.—These included several implements of war, articles of dress, and ornaments. The most interesting were, perhaps, the necklaces made of medicinal roots and seeds: these are worn by both men and women. The finest necklace is made of otter's teeth and the horns of a very small antelope, called in the label on the necklace, "Peit". These horns are from 1 to 2 inches long, and taper to a point from the base, which is about $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter. The scientific name of the animal is *Cephalopus pygmæus* (or *cæruleus*); and it is said that the native name is Ipete. It is popularly called Blue Buck, and Pete; also Kleenbok. A long account of its habits is given in Drummond's 'Large Game'.

There were also exhibited two shell necklaces and a carved-wood comb, sent from Samoa by the late Robert Louis Stevenson.

Albatross.—The specimen exhibited was caught off the Cape of Good Hope with a fishing-line and bait by a young medical man, who was acting as surgeon on board a sailing-vessel trading between England and Australia. It has been stuffed by Mr Small, George Street, Edinburgh, and measures 6 ft. 6 in. from the tip of one wing to the other.

Flowers from Colorado.—This was a collection of showy flowers and other plants which grew in the neighbourhood of Denver, Colorado, at elevations between 5000 and 9000 feet above sea-level. The names of the plants have been revised by a member of the Society, Mr James Terras, assistant to the Professor of Botany; and the list contains the following European flowers: Alyssum maritimum, Arctostaphylus Uva-ursi or Bearberry, Delphinium elatum, Epilobium angustifolium, Equisetum arvense, Fragaria vesca or Wild Strawberry, Hierochloë borealis or Seneca Grass, Lupinus hirsutus, Potentilla fruticosa, Salix alba, Wallflower (*Cheiranthus* sp.) It includes also one Indian flower, Quamoclit vulgaris or Cypress Vine. These seem all to be naturalized in America, but the following are described as natives, in Asa Gray's 'Botany of the Northern United States': Acer spicatum or Mountain Maple, Aconitum uncinatum, Aquilegia cærulea, Argemone mexicana or Mexican poppy, Asclepias sp. or Milkweed, Castilleia coccinea, Corydalis aurea, Dodecatheon Meadia or Shooting-star, Erigeron or Western Daisy (two species), Potentilla simplex, Prunus virginiana or Choke-cherry, Rhyncosia erecta, Ribes aureum or Buffalo-currant, Rosa blanda, Rubus nutkanus or Flowering raspberry, and Thalictrum dioicum.

The following seem to be natives of the Southern United States, as the names are not to be found in Gray's book: Euphorbia marginata, Œnothera taraxifolia, Solanum rostratum, Cleome integrifolium or Skunkweed.

Among the flowers of which the names are incompletely given, occurs a very remarkable one to which the popular name of Buffalo-head is given: it is a species of *Pedicularis*.

By Mr W. Forgan, F.R.M.S.

Instrument for Microscopical Drawing.—This instrument consisted of a plane silver on glass mirror, the glass being silvered on the face by Liebig's process, by which the image of the object is projected directly down on the paper on the table without the observer having to look through either the microscope or any form of accessory apparatus. In this way the objects examined may be drawn at one's leisure, and the drawing left off and begun again without trouble. The instrument is only adapted for the lower and medium powers of the microscope.

New Apochromatic 8-millimetre Objective.—This objective is one of Zeiss's, and one of the most perfect glasses of its kind made. It has an aperture of 80°. It is well known that, with such an aperture and the necessary low initial magnification, it has hitherto been most difficult with any ordinary microscopic objective to resolve P. angulatum into dots,—that is to say, to show the hemispherical markings on this object. But this 8-millimetre glass does so perfectly, using a deep eyepiece, which its most perfect achromatism allows one to use with it. When it first came into Mr Forgan's possession, it was some time before he was able to use it at its best, the reason, as it was subsequently proved, being that the microscope tube was too long. When the tube was reduced to 160 m.m. in length, the definition became at once of the most perfect description.

By Mr A. B. Steele.

Pearls found in the Shells of the Common Mussel at Cramond.—These pearls were found in specimens of the common mussel (*Mytilus edulis*) gathered last summer on the shore at Cramond. Almost all the mussels contained one small pearl, and some of them had more than one. In technical language they are termed seed-pearls, and are interesting merely as curiosities. One or two, however, were about the size of a small pea, and had the beautiful rose-tint of Scottish pearls, but unfortunately these were not discovered until the mussels had been cooked. Although there is no instance on record of a pearl of any value having been found in the common mussel, yet, from the size and transparency of several of these pearls, there is reason to think that gems of some commercial value may yet be found in the Mytilus edulis.

By Mr Coats.

Chili Dragon-fly.—This dragon-fly (*Phenes raptor*) is said to be the largest in Chili, and is $3\frac{3}{4}$ inches in length of body and 5 inches across the wings. The specimen exhibited was a very fine one.

By Mr Hugh Fraser.

Spruce-fir Gall Aphis.—Specimens of the galls of the Fir Aphis (*Chermes Abietis*) were exhibited, attached to young twigs of the tree; and the life-history of the insect was traced, from the gall to the imago or perfect insect. It was explained that the only mode of destroying this insect pest was to burn the infested twigs, when the gall made its appearance in May.

Fruiting Fig.—A Brown Turkey fig-plant, one year old, was exhibited growing in a pot, and bearing eight well-formed figs. This precocity in fruiting was attributed to the cutting having been taken from a well-ripened shoot of an old fig.

ANNUAL BUSINESS MEETING.

THE Annual Business Meeting of the Society was held at 20 George Street, on the evening of October 26—Dr Sprague, President, in the chair. Mr Moffat having intimated that he would not seek re-election as Secretary and Treasurer, it was resolved to take this opportunity of disjoining the two offices; and Mr A. B. Steele was then appointed as Secretary and Mr Wm. Coats as Treasurer. Dr Sprague was re-elected President, and Dr Davies and Mr W. C. Crawford, M.A., Vice-Presidents. Mr John Lindsay was re-elected Editor of the 'Transactions' of the Society and Librarian. For the vacancies in the Council the following were elected—viz., Messrs Day, Heggie, and Rankin; with Mrs Carphin and Mrs Bryden, who are the first ladies elected to this office in the history of the Society. The auditors appointed were Messrs R. C. Millar, C.A., and J. T. Mack. The balance in hand, after paying all outstanding accounts, was reported to be £2, 5s. It was resolved to ask the members to contribute to a special Publication Fund, and to continue the publication of the 'Transactions' from the last published Part to the present date.

The following motion was moved, seconded, and unanimously adopted: "That this Association desires to take the opportunity of Mr Moffat demitting the office of Secretary and Treasurer, which he has held for more than twenty years, to record their recognition of his long and valuable services to the Society, and to elect him an Honorary Member."

It was intimated that six indoor and eleven outdoor meetings of the Society had been held during the session. The following are the dates and localities of the excursions: April 26, New Hailes; May 5, Roslin Glen; May 12, Ratho; May 19, Kirkcaldy; May 26, Donibristle; June 2, Dalmeny and Hopetoun (driving); June 16, Elie; June 23, St Andrews; June 30, North Queensferry; July 7, Balerno; July 14, Gosford.

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TRANSACTIONS

OF

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SESSIONS 1894-96

Published for the Society

BY

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MDCCCXCVI

Price to Non-Members, Four Shillings.

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I.—*NATURAL HISTORY NOTES ON JAPAN.*

By Dr WILLIAM WATSON.

(Read Nov. 24, 1894.)

Some of you may know Leplay's analysis of the various nations of mankind. He divides civilised man into five groups — fishermen, hunters, agriculturists, shepherds, and camel-drivers; with two groups of uncivilised men—fruit-eaters and shellfish-eaters. This division is almost as important as the race division into Caucasians, Mongols, and Negroes; or the language division into Aryans, Semites, Turanians, &c. Adopting Leplay's divisions, the Japanese belong to the fisherman group. When not fishermen, they are agriculturists. There is no trace of the hunter or the shepherd in Japan. There is hardly any game in the country, except a few deer, and wild pigs, and a very few black bears, so there are no hunters. There is hardly a cow, sheep, or goat in Japan, so there are no shepherds. The people live entirely on fish and bread, as the Jews did in Christ's time, and as the Greeks did in the time of Pericles. This is a very different diet from the beef and bread of the Englishman, the bread and lentils of the Hindoos of Upper India, or the dogs and pigs which are consumed by the Chinaman.

The Japanese character may be divined from his mode of life and his food. He is the Shetlander of the East. A fisherman—and many Japanese are fishermen—goes into the open sea, leads a lonely life, and is naturally quiet and reserved. He is fearless of danger, self-reliant, and self-sufficing. The men live together in their boats, the women together on shore, so that men and women do not spend their time so much together as they do among agricultural or pastoral races. The women are quite unlike those of an agricultural race. Everything is in their province except the boat. As a fighting man, a fisherman in many ways excels the other four types. He is often a smaller man than they are; but he has acquired the habit of acting together, which they have not got until they enlist as soldiers. In a battle an army composed of fishermen may be inferior to a trained army drawn from an agricultural or pastoral nation; but in a long war they are superior to either. As the Roman poet said of his people—

> "Ut populus Romanus victus vi et superatus prœliis
> Sæpe est multis, bello vero nunquam in quo sunt omnia."

It must be remembered, however, that the Japanese are not pure fishermen like the Shetlanders. They are mixed agriculturists and fishermen; but, as I said before, the pastoral and hunter type is not represented in Japan.

The plants of Japan have been arranged in five zones, beginning at the level of the sea and going up to the tops of the mountains, each zone having a characteristic plant:—

1. The lowest is the zone of Ficus Wightiana.
2. The zone of Pinus Massoniana and densiflora, which grow together. The Japanese call the one "wo matsu" or male pine, and the other "me matsu" or female pine.
3. The zone of Fagus sylvatica.
4. The zone of Picea Veitchii, the small-coned silver fir.
5. Pinus parvifolia, the five-leaved pine, called by the Japanese "gojo no matsu."

There are fine forests of chestnut, oak, and maple trees, but the most common trees in Japan belong to the Coniferæ. Among them may be mentioned Salisburia adiantifolia, the silver-nut tree, with broad leaves; Retinospora obtusa, the tree of the sun; Cryptomeria japonica, with sickle-shaped leaves, called the evergreen tree; and Cryptomeria elegans, which changes in winter to brown. The most remarkable trees, not belonging to the Coniferæ, are Rhus vernicifera, the lacquer tree; Rhus succedaneum, the vegetable wax-tree; Broussetia papyrifera, from which paper is made; Camellia japonica; Paulownia imperialis (Scrophularineæ); and Cleyera japonica, planted round Shinto temples. Of flowers, we may mention the peony (*Pæonia moutan*); the chrysanthemum, the badge of the victorious Mikado and his adherents; and the three-leaved Asarum, the badge of the vanquished Toku gawa family, who till 1868 ruled Japan. The twelve months of the year are marked by twelve flowers, each month receiving its name from the flower which is then in perfection :—

January	The camellia.
February	The prune blossom.
March	The peach ,,
April	The cherry ,,
May	The wistaria.
June	The iris.
July	The peony and lotus.
August	The hibiscus.
September	The eulalia grass.
October	The chrysanthemum.
November	Another species of camellia.
December	A third species of camellia.

Of cereals we may mention maize, rice, rye, called "naked mugi"; wheat, called "little mugi"; and barley, called "big mugi."

Of insects, the most noticeable are the cicada, which beats two drums on its belly; and the tree grasshopper, which plays the violin, using its elytra as a fiddle and the rough edge of its thigh as a bow. The Japanese keep them in cages.

Of birds I may notice Parus caudatus, found in Britain, and Icteria princeps, a flycatcher—the most beautiful bird in Japan.

At this meeting Dr Sprague, the President, read a paper entitled "Ripple-marks on Sand."

II.—*GEOLOGICAL NOTES FROM ARRAN.*

By Mr T. CUTHBERT DAY, F.C.S.

(*Read Dec. 26, 1894.*)

I daresay most of the members of this Society have some time or other visited the island of Arran. Such a lovely spot cannot fail to attract many visitors in the summer, especially as the place is within easy reach. I only propose to-night to lay before you a few geological observations made during a fortnight's stay in Arran, and to exhibit some specimens of various rocks and fossils collected at the same time. To all people proposing a geological visit to the island I would recommend a perusal of Bryce's book on Arran. Mr Bryce spent many years in the place, and mastered the geological details with much energy and perseverance. His book is divided, for convenience, into a series of very interesting excursions, in which he points out what to look for and where to find it. It is very evident that Mr Bryce was a man of great endurance, for I found, when trying to carry out his directions, that I could not get over half the ground or get through anything like the amount of work which he gives for a day's excursion. I must acknowledge, however, that without his guidance I should not have been able to see one-fourth part of the interesting details which actually came under my notice.

Geologically, Arran may be divided into two districts of very different character by a line drawn from Brodick Bay in the east to Dougrie in the west. North of that line we have metamorphic rocks of a slaty nature, which occupy the coast-line on the west and for about 1½ mile inland; they also occur to the east, but are separated from the sea by a narrow margin of Old Red Sandstone, and rocks of carboniferous age. They also follow in a narrow band the line drawn from Brodick Bay to Dougrie. Inside this belt of metamorphic rocks there occurs an immense intrusion of granite which makes up the bulk of the northern part of Arran. It is to the denudation of this great granite mass that we owe the picturesque assemblage of rugged heights which characterise this portion of the island, including Goat Fell, Ben Nuis, the Castles, and many others.

South of the line mentioned, from Brodick Bay to Dougrie, the country consists of hilly downs quite different in appearance to the scenery in the north, and the rocks are made up for the most part of Carboniferous strata with their associated volcanic rocks. There are two districts in which a species of granite occurs in these newer rocks which I shall notice later. Between the Carboniferous rocks of the south of the island and the slates of the northern district there runs a narrowish band of strata, widening considerably to the west, which I believe have been referred to the Lower Old Red Sandstone.

Having now got a sort of general idea of the geology of the island, we will proceed to make a few scattered observations here and there, not according to any definite plan. A walk along the sea-shore, either from Brodick pier to Corrygills, or from Brodick Castle to Corrie, exhibits a fine example of the younger raised beaches: the amount of elevation is small, but the shore generally consists of a low rocky platform above the reach of high tide. This platform is bounded on the land side by more or less elevated cliffs, in which may be seen, in many places, the old sea-caves worn out by the waves at the time when the sea extended to their base. The rocks of the shore towards Corrie consist of red sandstone, and towards Corrygills of more or less coarse conglomerates of lower carboniferous age; their general strike appears to be nearly N.E.-S.W., and the dip 20°-23° to S.E. Many fine examples of false bedding are to be observed, in many instances to quite an exaggerated degree.

The most interesting feature to be observed on the Corrygills shore is the curious way in which the sandstone and conglomerate rocks are intersected in all directions by intrusive dykes of igneous rocks. These run for considerable distances, and are of all widths, from a couple of feet or so up to at least 100. Their position has probably been determined, in the first instance, by cracks or fissures in the rocks. It is hardly possible, at least in the case of the narrower dykes, that they can have eaten their way through the strata in a molten state, for if so they would have become so impregnated with the material through which they passed that their composition would have approximated more or less to that of the rocks among which they occur. This, however, does not appear to be the case. The dykes are easily recognised as of igneous origin, and do not show any particular difference even at their surface of contact with the older rocks among which they are found. Their intrusive character is easily established by the fact that they have hardened, in a more or less degree, the sandstones and conglomerates in their immediate vicinity. Most of the dykes are composed of a kind of whin or basalt, of such a nature that it is more susceptible to the action of the weather and other agents than the surrounding rocks. The consequence is the dykes have in a great measure disappeared, and their position is indicated by more or less wide fissures in the hard sandstones and conglomerates, most of them running in fairly straight lines, and imparting a striking appearance to the rocky platform. I have two specimens of these dykes, one of the basalt variety and the other of quartz felsite. The dykes of the latter material still stand rather higher than the rocks among which they are found. It is curious to observe the different degree of action on the surrounding rocks effected by these dykes at the time when they were intruded in a molten condition. No rule can be laid down; many of the more insignificant dykes appear to have had a greater effect in hardening the rocks with which they are in contact than some of the more important ones. I have some specimens of hardened sandstone and conglomerate collected in the immediate neighbourhood of two dykes. Some of the dykes that run across the shore inland may be traced up the face of the cliffs to a great height, showing that the now low platform of the shore must at one time have had an equal elevation.

At some little distance past Corrygills, towards Clauchlands Point, there is to be seen in the face of the sandstone cliffs a large vein of that peculiar igneous rock pitchstone, which runs in a nearly horizontal direction. The rock has assumed a prismatic structure on cooling, the prisms standing nearly vertical and in close contact. It is an extraordinary vein, and looks on close view almost like a wall of dark bottle-glass, about 10 feet high. I secured a good specimen *in situ*, and also a fragment of the sandstone in immediate contact below, which, however, does not appear to have been altered to the extent one might have expected.

On the shore, just opposite Corrygills, there stands an immense boulder of granite, estimated to weigh 210 tons, which has been brought by glacial agency from the Goat Fell district, the granite of which it is composed corresponding exactly with that of the place indicated. Numberless other boulders of granite, though for most part of small size, derived from the nucleus, are to be seen scattered about everywhere.

Very few fossils have been found in the sandstones and conglomerates of the shore. Mr Bryce states that he was fortunate enough to discover a rather fragmentary specimen of orthoceras, the species of which he was unable to determine. I spent half a day specially hunting for fossils in this district, and searched all the spots I considered likely to turn out productive, but without an atom of success.

We will now for a short time transfer our sphere of operations to Glen Rosa. The walk to this place is one of the prettiest in Arran, and the prospect on all sides, to quote the words of a poet whose writings have been a good deal before the public of late, "Most beautiful to be seen." On the way we pass close to Brodick church, a small edifice almost buried from sight in a wood. Under the north wall of the churchyard there occurs a band of limestone, which, however, has been almost wholly removed by quarrying operations. In the remaining portion I found, after half an hour's search, a small specimen of Pinna flabelliformis.

Resuming the journey to Glen Rosa, we pass over the upturned edges of the Lower Old Red Sandstone series and then on to the metamorphosed slates. This rock is well exposed in the bed of Glen Rosa Water, and appears to be considerably hardened even at a good distance from the granite.

At a point less than 100 yards below the confluence of the Garb Allt with Glen Rosa Water is to be seen the junction between the granite and the slates. The exposure is in the bed of the stream, and is not now so obvious as it was. The actual junction is much obscured by *debris,* and I could not find a spot where the granite in mass could be seen in close contact with the slates, though I waded about for a couple of hours or so trying to hit on it. However, I managed to secure a specimen very close to the junction, which shows the slates much altered and mixed with the intrusive granite.

The granite of this district is of rather a coarse texture, and the mica in it is of the black variety known as "biotite." The granite appears to be very susceptible to weathering agencies, and it is curious to note how it is breaking up into great sheets and slabs as it were, and the sides of the hills of which it is composed appear to be peeling off like the coats of an onion. On account of the facility with which this granite undergoes disintegration, it is difficult to obtain a good clean specimen. After much labour with the hammer and chisel, I did manage to secure a fairly good piece in Glen Rosa. The day I ascended Goat Fell I took my tools, expecting to get a further supply, but was disappointed. All the granite I met with was so rotten that with all the labour I expended I could not find a piece to satisfy my expectations. That this huge mass of granite in the north of Arran is of an intrusive character is established by the fact that the strata among which it occurs has apparently not had its dip altered to any extent. The slates dip away from the granite in some parts and into it in others, showing that the molten granite ate its way into the superincumbent mass and occupied its place. It must, of course, have been solidified very slowly, and at a great depth below the surface, or it would not possess the crystalline character it has. That it now appears considerably above the level of the surrounding rocks is owing to the fact that they are of such a nature as to be more easily eroded. Since the intrusion of the granite an immense mass of overlying strata must have been removed; and after the exposure of the huge dome-like boss of granite, it has itself been deeply trenched by atmospheric agencies till the district has at length assumed its peculiar rugged aspect.

A journey across the island from Brodick to Blackwater-foot well repays the geologist in interesting details. There are two so-called coaches which undertake to convey tourists for a moderate charge, but they are so badly horsed that my feelings of consideration towards the poor creatures forbade me to add my modest weight to their burden. The proprietor, I am told, is regularly prosecuted by the Society for the Prevention of Cruelty to Animals about once a-year, but he appears to prefer paying the fine and keeping bad horses as being the more profitable course to pursue. Under the circumstances, I hired a conveyance for the day, which had the advantage of my being able to keep it waiting at any convenient point of interest. On the way to Blackwaterfoot we pass two districts where granite occurs among strata of undoubted carboniferous age. Both granites have the same structure, and are of a peculiar appearance, hardly looking like the rock that generally bears that name. The interest attaching to them is that they are considered to be of Tertiary age, and are, so to speak, very young granites. I believe the main evidence in support of their age is that they very closely resemble granites of the Tertiary period found in other districts. The eastern patch is called the Ploverfield granite, and the western the Craig Dhu granite. I do not know whether their relation to the great granite nucleus has been made out, but in certain districts of the great nucleus there occur large masses of a fine-grained granite very similar in structure to the granites of Ploverfield and Craig Dhu. This fine-grained granite is supposed by some geologists to have been intruded into the general mass of the much coarser granite, and therefore to be of considerably later date. I did not have an opportunity of inspecting the fine granite of the nucleus, and am not therefore in a position to offer an opinion as to the connection between it and the granites of Ploverfield and Craig Dhu. At a spot near Glen Loig bridge, which crosses Glen Craisag Water, and high up in the hills to the south of the road, there is to be seen an old limestone quarry. The limestone is of a hard crystalline nature, and has been much metamorphosed by the intrusion of a mass of quartz felsite. The two rocks are to be seen fused together. It is difficult, however, to get a specimen showing this well, as there is a tendency to fracture at the junction under the hammer. However, after half an hour's work, I managed to secure a fair example.

On arriving at Blackwaterfoot a stroll may be taken along the shore to Drumadoon Point, where a large dyke runs out to sea. This dyke is composed of a rock which I have termed felspar and quartz porphyry: it is composed of a grey ground-mass, in which are scattered fairly large crystals of felspar and quartz. It is much weathered, and a good specimen can only be obtained by a considerable expenditure of labour with chisel and hammer. At Drumadoon Point there are high columnar cliffs composed of this same rock, and it has a peculiar appearance, owing to the decomposing action of the weather. The whole columnar front of the cliffs—and the columns are very marked—is covered with a growth of moss and lichens, and reminds one of an old moss-grown ruin more than anything else. Most igneous rocks exposed in this way generally present a bare barren aspect, such as basalt and the dolerites of Salisbury Crags, for instance. The base of the cliff is strewn with huge fragments of fallen columns, and when examined at a new fracture they appear to be weathered to the very core.

Of igneous rocks occurring among the Carboniferous strata in Arran, quartz felsite is much the commonest.

Referring once more to the pitchstones,—in Monamore Glen, near Lamlash, there are in the bed of the stream, near the entrance of the glen, two large beds of this rock. In one of these beds two kinds of pitchstone are found—the ordinary glassy variety, and a variety called spherulitic pitchstone. The latter kind is found in the middle of the vein, and the spherulitic structure is due to the fact that this part of the vein was cooled from the molten condition more slowly than the outside portions, thus giving time for incipient crystallisation to take place. I obtained a specimen of pitchstone taken from this spot, and also a piece of slowly-cooled ordinary bottle-glass, which also shows numerous spherulites scattered through its mass.

In concluding these brief notes I will just call attention to the beautiful mottled or poikilitic red sandstones, which are very abundant near the place called Fallen Rocks. The Fallen Rocks are about two miles from Sannox. They are an immense ruin of Old Red Sandstone blocks, which has been formed by the collapse of a high far-up cliff. I believe the slip happened some eighty years ago, and that the noise of the fall was heard on the mainland. They form a magnificent spectacle, and are well worth a visit on that account alone. The mottled red sandstones are to be seen on the shore *in situ,* and are for the most part of a brick-red colour, simply spotted all over with more or less circular patches of a pale-green colour, due probably to the presence of an iron silicate, while the iron in the red part is still in the form of the red oxide. The phenomenon is common enough in red sandstone, but here it is particularly striking, and I have a specimen from the spot. These mottled sandstones, I am informed, are characteristic of sandstones which have been laid down under inland-sea or lagoon conditions.

For those who are desirous of fossil-hunting in Arran I can recommend a visit to the old disused limestone quarry at Corrie. The quarry is in the form of large caves hollowed out of the hillside, and the limestone, which is of an impure quality, occurs in bands with marly layers interstratified, and overlaid by sandstones. The strike of the beds is 35° W. of S., or nearly N.E. and S.W., and the dip about 36° towards the S.E. The most plentiful fossil is Productus giganteus, which is met with in hundreds of thousands. It is difficult, however, to find a perfect specimen. After a good deal of trouble I managed to get one entire from a weathered fragment. I also found Productus scabriculus, Spirifer striatus, a fish-tooth, and a large impression of a species of nautilus, also orthoceras, and a few others.

I may just notice the patch of Old Red Sandstone on which the village of Sannox stands. Its presence at this point is due to an anticline or arch-like fold in the strata. The Carboniferous sandstones on the south boundary dip towards the S.E., while those on the north boundary dip to the N.W. —that is to say, in opposite directions—showing that these rocks at one time were continued over the top of the arch, but owing to agents of detrition the summit of the fold has been removed, exposing the older red sandstones beneath.

In conclusion, I hope these observations may have proved of some interest. They serve to illustrate how one's rambles in holiday-time may be made to furnish instruction as well as exercise. Though to many people a bag of specimens brought home at the end of the day may appear so much rubbish, still I think you will admit there is something to be learned even from a few handfuls of "knappit stanes."

III.—*CATS.*

By Mr J. G. GOODCHILD, F.G.S., F.Z.S., Etc.

(*Read Dec. 26, 1894.*)

To exhibit the general aspect of the various members of the Felidæ, Mr Goodchild placed upon the walls of the meeting-room large coloured drawings from life of nearly all the species at present recognised. The drawings were by himself, chiefly after the work of Joseph Wolf, "the prince of animal-painters."

The salient points in the structure and in the natural history of the chief forms were briefly noticed, and Mr Goodchild then went on to describe some of the more interesting of the extinct species, mainly with a view to dealing with the genesis of the cats as a family. He speculated whether the lion which, since the advent of man, contended with him for the possession of Britain, and which is known to have closely resembled the African lion in structural character, was not a rough shaggy beast, with its body covered with the long hair of which the mane is one of the surviving vestiges. He further speculated as to whether the coat of the British lion might not have been spotted, as are the coats of the lion cubs of the present day.

IV.—*DO TROUT PURIFY OR POLLUTE WATER?*

By Mr TOM SPEEDY.

(*Read Dec. 26, 1894.*)

In reading a paper to this Society on such a subject as the present one, I feel myself incompetent either to do justice to it or to impart information to the members upon it. My object in giving you the paper at all is rather with the view of acquiring knowledge from the discussion which I trust will follow my placing it before you, than any hope that I may have of imparting information which may be new to the members.

Having a small aquarium in my house in which I have from time to time kept various species of fishes, as also frogs, newts, molluscs, gammari, &c., I have—though of course in artificial circumstances—had opportunities afforded me of studying the habits and peculiarities of these different creatures.

Before the law of gravitation was understood, the inhabitants in many cases depended on a well for their water-supply, and even at the present day in many country villages the same thing exists. A popular notion prevails that a trout in the well is indispensable in order that it may eat up any animalculæ that might constitute pollution, and my observations and experiments throughout life very generally corroborate this theory. Those who have been at the trouble to observe a filter-bed after the water has been run off must have been struck with the correctness of this opinion. I have frequently been interested in watching the water being run off from one of the filter-beds of the water-supply of our own city. Despite the number of trout, eels, pike, and perch in the reservoir, the quantities of Limnææ, Gammari, &c., are incredible. To those who know the immensely prolific nature of these aquatic creatures, and the amount of larvæ and spawn which they produce, the gross pollution they would cause without the aid of scavengers in the shape of fish must be very apparent. As an experiment, I put half-a-dozen molluscs (*Limnæa peregra*) into a crystal tumbler among water clear as the crystal itself, and in twelve hours the water was very sensibly muddy. Some capsules containing the eggs of the molluscs adhered to the sides of the tumbler. When it is taken into consideration that this happened without the Limnææ having anything to eat, it will be readily believed that in natural circumstances, with abundance of food, the pollution must have been far greater.

That Limnææ, Gammari, &c., constitute the food of small trout is well known. It is a never-failing law of nature that wherever any creatures are found which multiply fast, checks are also found by way of counterbalance. Divest a lake of fish and the creatures referred to would increase amazingly, with a corresponding amount of pollution as the inevitable result. Take, for example, the Alnwick Hill reservoir. The spawn of the Limnææ are to be seen on the stones, despite the scavengers in the shape of fish which people the pond. The water naturally lowers through the day, leaving the spawn to shrivel and dry up in the sunshine, thus destroying its fertility. As the volume of water rises again in the evenings, it washes the half-dried and lifeless spawn back into the reservoir, to generate there millions of bacteria.

Remove the scavengers in the water and Nature will provide others of a different character. Molluscs are greedily devoured by a variety of waterfowl, including tufted duck, pochard, scaup, golden-eye, &c., and it is needless to say that most people would prefer fish to ducks in their water-supply. Then there are the wading scavengers, which devour all the various kinds of minute aquatic life. Loch Leven affords a familiar illustration. Who has not observed, when passing in the train, the numbers of peewits, curlews, oyster-catchers, redshanks, sandpipers, &c., wading in the shallow water at the edge of the lake. I have frequently killed and dissected numbers of those birds when feeding in such places, and on examination of the contents of their gizzards I have been forced to the conclusion that before I could drink of the water of these lochs it would require a little of something to "qualify" it.

There is no doubt that the water must in some measure be contaminated by the excreta of these birds, but the pollution they cause is not to be compared to the purification they accomplish by eating up so many of the organisms referred to.

While I believe that an amount of purification is traceable to feathered scavengers, I am strongly of opinion that the finny tribe are entitled to the credit of a great deal more. That fish pollute water to a certain extent is, of course, manifest, but my contention is that it is infinitesimal as compared with what the pollution would be without them. I have examined microscopically the pollution caused by birds, fish, and molluscs, and the last-mentioned is very filthy indeed, It has been asserted that fish frequently die in ponds, lakes, reservoirs, &c., and that when decomposition takes place gross pollution must ensue. This does not comport with my own experience, as I have found that after a dead fish lies at the bottom for a few days it then rises to the surface, floating back downwards, and that, buffeted by wind and waves, it ultimately gets driven ashore, when its bones are picked clean by rats, carrion-crows, and other land scavengers.

By a wise provision of Nature aquatic weeds generally grow luxuriantly in sheltered bays in a lake, and any pollution facilitates their growth, by which means the water is purified. So much is this the case, that in my small aquarium it is only necessary to change the water once or twice a-year when a plant is growing, whereas without the growing plant it must be changed weekly. When wandering amidst the hills, who has not observed among the green-coloured moss springs bubbling out from the mountain-sides, and as soon as the waters of a few of them trickle down and join together so as to constitute a streamlet, there trout will be found, and where it would be an abuse of language to mention pollution.

Some months ago an interesting proof was led in the Court of Session which bears pretty much on the subject in hand. The water trustees of the town of Falkirk sought to interdict the proprietor of the Denny reservoir, from whence the town is supplied, from putting some trout-fry into it. On both sides scientific witnesses tendered the most conflicting statements, some of them going the length of asserting that they had examined the water carefully, that there was not food in it for fish, and that the trout introduced would be sure to die and pollute the water. The case lasted two days, and finding I was not to be examined till the second day, I arranged with the factor of the property to have some fish caught in the lake that night and forwarded by first train in the morning. I thereupon marched triumphantly into court with an ashetful of the fattest trout I ever witnessed. On dissecting the stomachs of some of the trout I found them full of Limnææ, Gammari, and the larvæ of various aquatic insects. The judge very properly, as I think, decided in favour of the trout. It may be thought that as Lord Low, in the case just cited, has laid down the law on the subject, the question at the head of my paper has been answered. But the scientific evidence at the trial was really of such a conflicting nature that it was very evident much difference of opinion on the subject existed.

Personally I was of opinion that instead of spending so much money among lawyers, it would have been much more satisfactory to have handed the question over for solution to the Edinburgh Society of Field Naturalists.

V.—*ON FLIES.*

By Mr P. H. GRIMSHAW, F.E.S.

(*Read Jan. 23, 1895.*)

After some introductory remarks showing how little flies have been studied as compared with the other orders of insects, Mr Grimshaw dealt with the general characteristics of flies, and pointed out in what particulars they differ from other insects. For example, they only possess one pair of wings, from which character the technical name of Diptera is derived; they have a complete metamorphosis, passing through all the stages of egg, larva, pupa, and imago; they have piercing and sucking mouth-parts; and possess a lateral, stalked, suctorial stomach, as in Lepidoptera. The nervous system varies in its degree of concentration: in stout-bodied flies the principal ganglia are fused into one large thoracic mass, while in the slender-bodied species there are three separate thoracic and a chain of five or six abdominal ganglia. The external structure was then described in greater detail, taking in order the head with its various parts, the different forms of antennæ, the shape of the face and structure of the mouth-parts; the thorax, with its appendages, the legs, wings, and halteres; and the abdomen, composed of from five to nine segments. The life-history of flies was next dealt with, and attention drawn to the modern method of classification founded upon the nature of the pupa and method of emergence of the imago.

Mr Grimshaw concluded with a short sketch of the characteristics of the principal families, and with remarks on the more remarkable features in the life-history of several well-known species.

VI.—*DAUBENTON'S BAT* (VESPERTILIO DAUBENTONI),

As observed in Glen Dochart, Perthshire.

By Mr SYMINGTON GRIEVE.

(*Read Jan. 23, 1895.*)

Between Luib and Crianlarich stations on the Oban railway the line passes up Glen Dochart and along the shores of two lochs. The first and longer of these is Loch Ure (or, according to the spelling in the Ordnance Survey map, Loch Iubhair); and the other, with its prettily wooded island and ruined castle, is Loch Dochart. The whole district is so well known for its associations with St Fillan, the Black Campbell, and Sir Walter Scott's hero Rob Roy, and for its botanical interest, that I need hardly have written these introductory lines were it not that many of those who hurry through Glen Dochart on the railway, or at most only spend a day in passing, leave under the impression that there is but one loch in the glen, and that it is called Loch Dochart. The fishers who visit the lochs know better; but they are so few in numbers compared to the multitudes who merely pass by, that it is as well to give the foregoing short explanation.

The two lochs are connected by a deep, slow-running portion of the river Fillan, the waters of which, after passing through Loch Ure, leave it by the river Dochart. On the north-western shores of each loch the spurs of Creag Liuragan descend at several points in precipitous rocks into their waters. It is at such places where deep fissures occur in the rocks that the bats are to be found. They seem to prefer those fissures that are found in the face of the small cliffs that descend perpendicularly into, or in some cases overhang, the water. As such cracks in the rocks can only be examined from a boat, the bats are quite protected from the intrusion of most other animals. They, however, have one or more of their colonies established high up in a cliff, the foot of which can be reached from the shore; but, as far as we could discover, they had chosen positions where they were quite safe from intrusion.

For about six or seven years I have had many opportunities of watching the bats that frequent these cliffs, and, as far as one can judge by seeing them at close quarters night after night, they all appear to be of the same variety. I have caught the long-eared bat at Benmore farmhouse, which is on the opposite side of the glen from the rocks where Daubenton's bat is found, and I observed that variety there this summer; but I have never seen it hunting for its food over the waters of the lochs as is done by Daubenton's. The latter bat does not generally make its appearance until the shade of night has fallen and it has got pretty dark. We only observed it on fine evenings, and during wet weather observed its absence for a considerable number of consecutive nights. When they were about they seemed very busy, and several generally kept flying near our boat, dashing after our flies as we cast our fishing-lines with our rods. From what I have heard they seem sometimes to seize a fisher's fly and get caught, but my own experience has been that they have always discovered the fly to be only an imitation in time to save themselves, although they occasionally have had very narrow escapes.

Late one evening, during the summer of 1888, a fisher on Loch Ure, while casting, struck a bat with the point of his rod, and it fell dead into the boat. He kept the specimen for me, and I got it either the next or following day, and from what I recollect of it feel sure it was a Daubenton's bat. I sent it to a taxidermist in Edinburgh to get stuffed, but it was too long of reaching him. He wrote me that he could not preserve it satisfactorily, so had destroyed it. Had this specimen been kept even as a damaged skin, I have no doubt that Daubenton's bat would have been recorded from Loch Ure some years ago. Although I have watched the bats flying over both Loch Dochart and Loch Ure on many an evening since the summer of 1888, I had no opportunity of examining one until lately, although I have tried frequently to catch them.

On the 14th of July last, about 4 P.M., I was on Loch Dochart fishing, and as it had fallen a dead calm and we were having poor sport, I told my boatman to row the boat underneath a small cliff, on the face of which was a cavity in which a hawk had built its nest and was rearing its young ones. I had been watching this nest for some time previously, and only wanted to see what progress the nestlings were making. As we got close to the cliff, which dipped right down into the loch, my attention was attracted by an animated chirping. I at once guessed it was produced by bats, and after a little examination discovered that the sound came from a fissure in the rock. I looked about outside the opening, and seeing the droppings of bats, had my suspicions confirmed. I then put my face close to the fissure and peered in, and saw several bats clinging to the rock. They seemed to be in constant motion, and did not cease the chirping sound. I determined to try and capture one or more of them, and as I thought they might fly out if disturbed, I got out the spare top-piece of my rod. I found I could probe with it the farther end of the fissure in most parts; but when the bats felt its touch they climbed higher, and into the more inaccessible crevices, where it became more difficult to reach them. At last one bat came out and flew away before I could catch it. We watched it fly some distance down the side of the loch and then take refuge in a rocky bank amongst heather and ferns. Seeing that the bats could not be easily caught by hand, I thought of my landing-net. Holding it over part of the opening, I began to work with the top-piece of my rod once more. I soon caught a bat; then my next attempt brought me two old ones, and a young one which was clinging to its mother. When underneath the net on the stern seat of the boat the mother several times left its young one, as if anxious to escape; but its maternal love seemed to overcome all fear for itself for the moment, as it always returned to its young one, which clung to its parent. The little one was almost without hair, and was a very tiny creature, about three-fourths of an inch in length when rolled up. On the evening of the day on which it was captured it remained clinging to its mother's back, but the following day it lay rolled up in its mother's left wing. When I turned the mother over to see how the little one was clutched, I found that only a small part of the under surface of its body could be seen, and the outside of its mother's wing was doubled over upon it. The young bat grew rapidly, and by the morning of the 18th, when it was despatched to Edinburgh, was beginning to be covered with a fine dark down or hair.

I experienced a difficulty in feeding these animals, and found that although at first they took some of the lean of roast mutton chopped up very fine, they did not appear to care for the diet. Flies were not to be got in sufficient numbers, but any put into the box in which the bats were confined were neglected until night set in, when they were evidently eaten, as they entirely disappeared. As, however, it was the third day of the bats' captivity before I could procure flies for them, they were no doubt by that time very hungry. It is just possible that it was the mother bat that ate these flies, as what I observed later with male bats of the same species shows that they would not touch flies put into their box after a similar length of confinement.

As I knew that Mr Eagle Clarke was collecting bats for identification, I wrote offering to send him the bats if he thought it worth while to do so. He answered my letter saying that he would like to see them, so they were sent off by post. On the 20th July I heard from Mr Clarke that the bats were Daubenton's, and as the locality was a new one he would like me if possible to catch some more. I at once took my boat to the cliff where we had made the capture on the 14th July, only to find that apparently all the bats had left the fissure. My boatman and I searched for a long time, but at last discovered, in a fissure in a cliff above 70 feet high, and which descended almost perpendicularly into the water, another colony of bats, or perhaps the one that had flitted. This station is about 200 yards from the one where we first found Daubenton's bat. The fissure was very deep, and we could not get any stick long enough and at the same time small enough in circumference to reach to the end of it. We found the selected branch of a rowan-tree the most successful implement at our disposal, but it was not sufficiently rigid and soon broke. The bats may have had this as their abode for a long time, but there was not outwardly much sign of lengthy occupation, such as droppings, or the blackening of the edges of the rock at the entrance to the fissure by the rubbing of their bodies, as was seen at the place where we first found them.

The smell, however, on putting one's nose to the entrance, was sufficiently strong to point to lengthened occupation, and I am inclined to think it is an old resort, from the state of the droppings we brought out at the ends of the sticks we inserted into the fissure. These cracks are very narrow, not exceeding from a half inch to 4 inches in width at the outside of the rock.

Having discovered the bats, we tried very hard to capture some, and after much trouble we succeeded in catching a large male, which we had gradually driven by persistent probing from the depths of the fissure to near its opening, when it at last tried to fly out and was caught in our landing-net. We found that the other bats had retired to the inner part of the split in the rock, and, as we could not reach them, for the time determined to give them a rest, in the hope that some would gradually come nearer to the opening. During the afternoon of the same day we tried again, and succeeded after a great deal of trouble in starting several bats out of the hole, but only managed to capture one, which was found to be a large male. Both these males were in what seemed a state of great excitement when captured, and made far greater attempts to bite than those captured previously. From the way they turned upon the top-piece of my fishing-rod, which I used to drive them out of the fissure before they finally flew out, I came to the conclusion that they mistook it for some enemy, or more possibly for an opponent of their own kind and sex. I kept these two bats until the 23d July, and although I supplied them with live flies and various other kinds of food, they would not feed; so I then sent them by post to Mr Eagle Clarke.

I kept all the bats captured in a small box, into which I fixed a crossbar for the creatures to hang from, and made two small holes in the lid for air. At first, after being put into the box, the bats all huddled into a corner, and continued to do so for the second day. After that they used the crossbar, and hung suspended head downwards, as is usual with the species. They made a chirping noise, and were restless for a short time when first immured, but soon became quiet, and remained so until after dark, when they became very active, and made such a noise that they prevented sleep until put out of my bedroom.

At 9.30 P.M. on Thursday, the 26th July, I was out fishing on Loch Dochart with a friend, when we heard a strange wail coming across the water from the other side of the loch. It seemed to rise and fall, and attracted my immediate attention. As it grew louder I managed to locate it as coming from the most westerly of the cliffs in which the two male bats were got by me on the 20th. The boat on which we were fishing was distant from the cliff about 300 yards, yet the sound was quite loud, although the wind was moderately strong from the east and carrying the sound away from us. We rowed the boat about 50 yards nearer, and could hear the wail was caused by a great outburst of chirping, which reached a climax while we were at this place. As I could now easily recognise the chirping to proceed from the bats, I rowed the boat very quietly in the direction of the cliff. As the boat approached, the bats gradually lowered their violent chirping, and one or two of them appeared flying over the boat. We could make out that the sounds proceeded from two points in the cliff—one of them the fissure in which we found the two male bats, and the other a new station higher up the cliff, about 40 feet to the right of the former. This latter station we had not previously discovered, as it was too high up on the face of the cliff for us to reach without a ladder. The subdued chirping continued until we were alongside the rock, and holding on to it to keep the boat in position so that we might try if we could capture any of the bats. Whenever the boat bumped against the rock the chirping ceased, and all our efforts to get at the bats with the top-piece of a fishing-rod were unavailing.

I have no doubt from what we saw and heard that the chirping sound proceeded from the young ones, and that the rising and falling of the sound which in the distance reached our ears, and was heard like a wail, was caused by the arrival or departure of the old bats, who were evidently supplying their young with food. I have noticed that the young of some birds not only make a great deal of chirping when the parent birds bring them food, but also when, after feeding them, they leave the nest. To my mind something of the same habit is natural to these bats. As it has been impossible to verify this view by actual observation, owing to the nature of the places inhabited by these creatures, I only give the opinion I have formed as inferential, although what I have seen and observed has led me to this conclusion.

The altitude of both Loch Dochart and Loch Ure is given on the Ordnance Survey map as 512 feet above sea-level, so the various stations for the bats may be stated as from 516 to 540 feet. It is interesting to note that these lochs are situated so near the watershed of central Scotland. They are situated on the upper part of the Tay valley, and within a few miles of the watersheds of the Forth, the Clyde, and the Awe. The bats had chosen as their abodes positions, the accesses to which either were only approachable by water, or were so high up the cliff as to be inaccessible from land. That they had no fear of attack from some birds of prey is evident, as the bats first captured had chosen as a home a fissure within a few feet of a hawk's nest. Had an owl nested in such close proximity it would probably have been different.

In conclusion, it is as well to point out that it is almost certain that all the bats we saw hovering over the water were of the Daubenton's species, as none of those we captured were of any other variety. As mentioned, we have captured the long-eared bat at a house not far off; but these creatures do not frequent the lochs, as far as we have observed.

I have been asked to state how many specimens of Daubenton's bat I saw. This is a most difficult question to answer, but I am prepared to say I have seen dozens of them; and judging from the noise they made on the 26th July, when I heard the wail come across the water at a distance of at least 300 yards, they must have been present in hundreds.

At this meeting a paper was read by Mr W. C. Crawford, F.R.S.E., entitled, "On the Cultivation of some Flowering Parasites, and the Effects of Parasitism." The paper was illustrated by a number of lantern slides, prepared by Mr Crawford.

VII.—*GLIMPSES OF TROUT.*

By Mr TOM SPEEDY.

(*Read Feb. 27, 1895.*)

The title of my paper to-night is not an original one. Some of you may remember that a discussion on this subject was carried on for some weeks in the columns of the 'Scotsman' a month or two ago. While not a little of what was then written was most interesting, a great deal of it was of the nature of pure speculation and surmise. It is not my intention in the present paper to animadvert upon the discussion referred to. I shall rather endeavour, as briefly as possible, to expound my own views on the subject of trout and their enemies, and it may thus be seen how far these views are in accord with the opinions of the various writers in the 'Scotsman.' Having made a careful study of trout in all their variable conditions, and having had exceptional facilities for observing their habits, I trust my remarks may not be altogether uninteresting to the members of this Society.

To those interested in pisciculture, a visit to Sir James Maitland's breeding-ponds at Howietoun, near Stirling, will in an hour or two afford more information than can be acquired by the perusal of volumes. The first "glimpse" of trout to which I would call your attention is the parent fish upon the spawning-bed. In order to witness this interesting sight I repaired in the month of November to Dalnaspidal, in Perthshire, and, after darkness had set in, rowed three miles up Loch Garry, and "burnt" the river Shellain, which empties itself into the lake. Spreading tar on a sack after the manner of butter on a slice of bread, I rolled the sacking round, and nailed it to a long pole carried from home for the purpose, there being no trees in that wild and desolate region. Pouring a bottle of paraffin on the tar-besmeared sack, and putting a lighted match to it, I waded up the centre of the stream. I had now and then to walk ashore, through inability to bear the cold on my limbs; but with perseverance I got accustomed to this, and rather enjoyed it than otherwise. The vivid glare of the blazing torch in the dense darkness, the solemn silence that prevailed—not a sound being heard except the noise of cascades rushing over the rocky mountain-sides, or the plunging swish caused by my own footsteps as I waded abreast of the current—constituted altogether a wild and weird experience. There were numbers of fish upon the spawning-bed, but as these were chiefly salmon and sea-trout, they had no attractions for me. Farther up the stream I discovered many pairs of trout upon the "redd," the yellow-coloured denizens of the river being easily recognised from the dark-skinned frequenters of the lake, which had ascended to perpetuate their species. I there discovered a peculiarity among trout—viz., the occasional choosing of a partner much larger or much smaller in size than themselves. On a "redd" a female *Salmo ferox* of 10 lb. in weight was with a male of 2½ lb. For a long time I looked at them lying side by side, they doubtless wondering meanwhile what strange phenomenon the glare of the torch could be. Having arranged with a distinguished scientific authority to provide specimens for purposes of dissection, with the view of discovering whether the *Salmo ferox* was a distinct species, I lifted the female out with the aid of a gaff and despatched her on the grass. The male, taking fright by the splashing of his partner, rushed up-stream, but on returning to the water, I found he had come back to the identical spot where he lay before, when I secured him also. Personally, as well as in conjunction with professional authorities, I have dissected and examined numbers of these large fish caught in different Highland lakes, but have never been able to discriminate betwixt them and ordinary trout. I am disposed to treat them as simply overgrown monsters that for years have gorged themselves on the smaller trout that abound in the lochs they frequent.

After the spawn is safely deposited in the "redd" it is exposed to many contingencies of an adverse nature. Very frequently it is disturbed by thunder-storms, which bring down the river in spate, carrying stones and gravel before its impetuous force, altering the bed of the stream, and washing amongst the water the spawn from the "redd," which will doubtless be then devoured by trout in search of food. It almost seems an incredible thing in Nature that trout should devour the spawn of their own species; still it is true that they do actually devour it in large quantities, and nothing makes a better bait for fishing than preserved roe—though this, of course, is illegal. Many kinds of birds likewise feed upon the spawn of trout. If a farmyard is near a stream, swans, geese, and ducks do incalculable mischief. Wild ducks, coots, water-hens, dabchicks, and water-ousels are all blamed for devouring the spawn of fish. While I have no desire to dogmatise on the subject, I must confess that as to the last-mentioned I feel a little sceptical. With me the water-ousel is a special favourite, and I dislike destroying it even for scientific purposes. Must it be confessed that I have shot a few of them, but I am proud to state that in no case did I find in their maw the spawn of any kind of fish. I do not, however, regard this as conclusive testimony.

A large quantity of the spawn of early fish is destroyed by later ones disturbing the "redd" in depositing their own ova. The period of incubation of trout spawn is about two months, varying, of course, with the temperature of the water. As soon as the young trout issue from the eggs, they are assailed by numerous enemies. Notably among these may be mentioned kingfishers, herons, ducks, &c. The first-mentioned —the kingfisher—is now so rare in Scotland that it may almost be regarded as superfluous to mention it among the enemies of trout. Still it is a fact that, breeding more than once in a season, and having to cater for their six or seven young in a brood, the number of small trout they destroy is very great. It is extremely interesting to observe this bird in pursuit of its prey. I have often watched them sitting patiently on the branch of a bush or tall weed above a stream, till, sighting a small fish, they would dart like lightning into the water, remaining a second or two below the surface. On reappearing with a fish in their bill, they immediately flew off to feed their young, and it was by marking the direction of their flight that I have frequently discovered their nest. Sometimes they hover in the air like an osprey, until, perceiving a fish, they dart down on their victim. When they secure a small trout, they beat it against a stone to kill it before swallowing it; and so strongly are they endowed with this instinct, that I have observed, on giving a young one taken from the nest a bit of beef, it would beat it in the same manner, according to hereditary habit.

A deadly enemy to trout is the heron. The number these birds destroy, especially while feeding their young, is incredible. Rooks get credit for remarkable industry when catering for their nestlings, being seen early and late in search of food. *They* rest, however, in the hours of darkness; but it is not so with the heron. There is no eight, or even eighteen, hours' movement with them. At all hours of the day and night they may be seen industriously searching for food. At Halleaths, near Lockerbie, where there is a large heronry, and at other places, this can be verified. I have taken seven trout, varying from 3 to 6 ounces in weight, from the maw of a heron shot in a tributary of the river Garry. Their habit is to stand motionless in the water till a fish comes within reach, when with unerring aim and great violence they strike with their powerful sharp-pointed bill, leaving a punctured wound in the shoulder of their victim which generally proves fatal. Some years ago, when fishing in the Leader within the policies of Cowdenknowes, I witnessed a heron standing motionless by the river-side, evidently looking for his supper. Remaining perfectly still, I watched with considerable interest to see him secure his prey. His patience was superior to mine, however, as I was on the point of stepping out from behind the bush which concealed me in order to commence to fish, when I saw him suddenly strike at something in the water. On lifting his head, I observed an eel over a foot in length wriggling in his bill. Being aware of the slippery nature of his prey, he ran 30 or 40 yards out on to the meadow before laying it down. Giving the eel several pecks, he again seized the fish, though still wriggling, and managed to swallow it. Of the force of their blow and the sharpness of their bill I can speak from experience. I had been watching one for a long time fishing in a tributary of the Tweed, and resolving to shoot him in order to discover how many fish he had actually caught, I tried to stalk him. Few birds are more shy and wideawake, and before I got nearer than 50 yards he rose. I fired, and he fell with a broken wing. As he was on the opposite side of the brook, I sent my retriever to fetch him. He saw the dog approaching, and putting himself in an attitude of defence, waited his opportunity and struck the retriever on the cheek with great violence. Fearing that the dog's eyes might get some injury, I called him back till I got sufficiently near to despatch the heron with another shot. On examination, I found the savage bird had penetrated the dog's cheek to the bone, the wound bleeding profusely; and had it struck the eye, vision would certainly have been destroyed.

Ducks, both wild and tame, are destructive to trout as well as to spawn. Being nocturnal in their habits, it is most difficult to observe wild ducks feeding, but on several occasions I have seen the tame breed killing trout, and it is certain that their wild cousins will also do so. In the Braid Burn I saw a number of my neighbour's ducks "guddling" with their bills under the banks, and was amused to notice one bring out a trout about 3 inches in length in its mouth. The trout wriggled to escape, but for a long time the duck held it firmly till it became quiet, when it was swallowed head first. On another occasion, at Glencotho, in Peeblesshire, I saw a duck run out from a streamlet with a trout wriggling in its bill. It was evidently aware that it had an insufficient hold of the trout, and knew that if it escaped in the water it was lost, for it waddled 5 or 6 yards on to the grass, followed by half-a-dozen companions wanting to share in the prize. As the old adage has it, "There's many a slip 'twixt the cup and the lip," for the trout escaped from the very mouth of its captor only to be seized and swallowed by one of the "camp-followers."

Otters also are very destructive to trout, and in small streams which they frequent they destroy a great many of the largest-sized ones. It is, however, a mistake to suppose, as many do, that the food of otters is confined to fish. I have seen on a small island in the Tweed, overshadowed by the ruins of Norham Castle, nearly fifty spawned salmon lying dead, with only a small bit eaten out of the back of the head by otters. Within a few miles of the same place I have known them drag the rabbits out of my traps, and my ingenuity was taxed to the utmost until I discovered and secured the depredator. Fur is generally found in the droppings of otters, and by tracking them in snow it has been ascertained that, like the fox, they can catch grouse in their roosting-places.

There are other animals that may prey upon dead or sickly trout, though these I would not include amongst their natural enemies. I refer more particularly to rats. There is no doubt that the changes which have taken place in the habits of the race of *Mus* in recent years are most remarkable. I have therefore no desire to dogmatise on the subject, as I believe it possible that the brown rat (*Mus decumanus*) will enter the water and secure a sickly or half-stranded trout. I have known a pair of hoodie-crows, followed by their brood, discover a number of trout imprisoned in a small pool in a burn on the Ladykirk estate, which after a protracted drought was almost dried up. Attracted by their clamour, I wondered what was the cause of their excitement, till I observed one of them fly out of the burn with a trout in its beak, to be immediately followed by the whole brood. Alighting on a field, the trout was divided among the young ones, when the parent bird again repaired to the burn. Going to the spot, I found about a dozen trout imprisoned as described. In similar circumstances I have not the slightest doubt that the rat would take advantage of the occasion, but that he is a "deadly enemy" to trout is highly improbable. The water-vole, commonly called the water-rat, has also been blamed for destroying trout. This I do not believe. Having all my life taken an interest in such matters, and having shot and dissected numbers of these animals for the express purpose of examining the contents of their stomachs, I have been forced to the conclusion that their food is strictly of a vegetable nature.

Strange to say, among the greatest enemies to trout, with the exception, perhaps, of pike, are their own species. A trout two months old has been known to devour a number about half its age. Such are their cannibalistic tendencies, that unless they have plenty of insect food they will devour each other so long as there is much difference in their size. What is sometimes found in the stomach of a trout, as well as the size to which that organ will distend, would hardly be credited. In the Museum of Science and Art there is a trout stuffed which weighed 12 lb., and from the stomach of which I took, after it was caught, six of its own species, which weighed in the aggregate 1½ lb. In another, which scaled 14 lb., I found a trout partly assimilated, but which must have weighed 8 or 9 ounces, besides no fewer than five adult frogs. A third under 8 lb. had swallowed a half-grown water-vole, a frog, and two small trout.

Taking all the natural enemies of trout combined, the sum-total of the mischief done by them is insignificant when compared with the wholesale depredations of the poaching fraternity. It is but right to acknowledge that, so far as the Legislature is concerned, protection has been extended to trout by statute law. The defect, however, is in the administration of that law. Unless it be an occasional gamekeeper—who has generally other work to attend to—or a public-spirited shepherd, the poaching fraternity pursue their depredations without dread or molestation. For many years I have been aware that some of the finest trouting streams in Lanarkshire, Peeblesshire, and adjacent counties have been ever and anon harried by nets and kindred devices. This practice is invariably pursued during the night and early morning, the effect being that while all the small trout are left, few of the larger ones escape. This, I may state, is the true secret of the falling off in the numbers of large trout, and the real source of that disappointment of which the modern angler has uniformly to complain. I see no remedy for this state of matters except by the formation of local Anglers' Associations, and the employment of proper authorities to protect our rivers and trouting-streams. The expense would be so trifling as not to be compared with the advantages certain to be derived. I would also recommend that a substantial reward be given to all shepherds, gamekeepers, station-masters, and others who would communicate such information as would lead to the conviction of those despicable offenders. If any angler desires to have his indignation stirred against this class, let him examine those trout which are occasionally to be seen in the windows of some of our fish-merchants, and he will notice upon many of them the marks of the meshes of the poacher's net. A few swift and heavy penalties is all that would be required to put an end to the proceedings of the mercenary trout-netters, who are veritable cowards at best. Were it not that it is my desire to avoid here everything of a personal nature, I could easily point to one or two of those shop-windows which are notable for the exposure of brown trout.

I would further suggest a close time for brown or yellow trout. It is surprising that while a close time for salmon and sea-trout has been properly provided for, and rigorously enforced, no such protection has yet been extended in the interests of fresh-water trout. Some of you will be aware that last session Lord Lamington introduced a Trout-Fishing Bill for Scotland. It is to be hoped that his Lordship will persevere with his bill, and that he will so amend it as to make the period of close time extend from the 1st of November to the 15th of March, instead of to the 1st of February, as is proposed in the bill. Every angler is aware that the thin and spent condition of the trout during February and the early part of March renders them comparatively valueless, while affording a minimum of sport. In order that his Lordship's hands may be strengthened in this laudable undertaking in the interests of anglers, I would recommend that every Anglers' Association in Scotland should petition in its favour. Especially would I appeal to the Loch Leven Fisheries' Directors to take action in the direction indicated. Their powerful influence could not fail to tell in securing the passing of the measure, which would prove a most acceptable boon to all concerned.

VIII.—*THE LITTLE AUK.*

By Mr CHARLES CAMPBELL.

(Read Feb. 27, 1895.)

The little auk, although not a regular visitor to our coasts, occurs every now and then in winter, and in sufficient numbers to remove it from our list of rarities. It has recently been attracting considerable notice, owing to the wreck of the species which has lately occurred on our shores. From the Orkney and Shetland islands down to Kent it has been recorded in varying numbers on the coast-line, and it has also occurred inland, as far west even as Loch Earn and Loch Lomond. A full account, however, of this present visitation is, I believe, being prepared for the April number of the 'Annals of Scottish Natural History' by one of the Editors.[1]

In the Firth of Forth the first one I noticed was on Sunday the 13th January, when the easterly gale was at its height. It was sitting alive among the bent that fringes the Dalmeny shore at Long Green Bay. Next morning another one was got alive and ten dead ones were picked up. On Saturday the 2d February, while on the Drum Sands at low water, I observed a little auk flying along the edge of the tide, and shortly afterwards at the Buchan Rocks I had the good fortune to see one disporting itself in its native element. It came drifting in with the tide to within a few feet of where I was hidden. Floating very lightly on the water, it pecked away every now and then at, to me, some invisible substance that floated on the surface. It made no attempt to dive. After resting some time in the calm water in the shelter of the rock it sat up after the manner of a duck, and, flapping its wings at a great rate, it rose and took flight across the Firth, never rising much above the surface of the water. Next day, the 3d February, I was somewhat surprised to find other six little auks lying dead on the beach. I thought at first that some fresh disaster had overtaken these birds, but it is more probable that those of their number that had found shelter in the Forth after the gale of 13th January had not all been able to find sufficient food in those waters to support life. On the 9th February a number of others were found dead between Queensferry and Barnbougle Castle.

Although almost every writer on natural history quotes instances of the occurrence of the little auk in unusual numbers, the present wreck of the species is perhaps the most widespread we have any record of. White of Selborne, in a letter to Thomas Pennant, dated 9th November 1773, mentions finding a little auk near Alresford. M'Gillivray describes it as of rare occurrence in Britain. Morris mentions it as being taken at Prestonpans in 1852, another in the Forth off Dalmeny Park in the same year, and a third at Cramond in 1853. Morris also mentions the large numbers that occurred all down the East Coast in 1846, which is likewise noticed by several other writers. Yarrell also gives an account

[1] See 'Ann. Scot. Nat. Hist.,' April 1895.

of one of these periodical visitations of the little auk in October 1841 on the coast of England from York to Kent, after a violent storm from the N.N.E. M'Gillivray mentions on hearsay evidence that the little auk has bred at St Abbs Head, and states having seen two himself on the Bass Rock during the breeding season. Gray, in his 'Birds of the West of Scotland,' notes having seen two of these birds on the same rock in the month of June, and gives other records of their being seen on the Scottish coast during the summer-time. The island of Grimsey, on the north coast of Iceland, however, is the most southerly point where the eggs of the little auk have been taken.

Enough can be gathered from these occurrences of this bird on our coast to show that its arrival is merely a question of weather, as they have invariably occurred after a storm or succession of storms from the N.E. It is to be remarked that they appear only in large numbers on our East Coast. On the West Coast, though a comparatively rare bird, it does not seem to be so very uncommon as is generally supposed. Mr Cecil H. Bishopp of Oban informs me that each winter for the past seven years he has received three or four little auks for preservation. This year, however, he says, beats the record, as he has had up to the present time twenty-six of these birds sent him. These were all from different parts of the West Coast, a number being from the lochs in the island of Mull and from the shores round about Oban. Last year he says a specimen was found dead at an altitude of 1000 feet and twenty-four miles from the sea. While averse to indulging in speculative theory, it seems to me quite possible that some of these birds recorded on the West Coast may have been blown right across the mainland of Scotland.

It is still an unsolved question where these birds are when they are overtaken by a storm or succession of storms, as in the present instance. Undoubtedly it is in some part of the North Sea, but it is somewhat surprising that we have no records of their having been seen there by mariners. This is the more remarkable when we consider the vast numbers of the birds which must annually leave their northern breeding-grounds on the approach of winter. Admiral Beechey records seeing a flight he estimated at nearly four millions in Magdalena Bay; and Professor Newton states that from what he saw himself in Spitzbergen, he does not feel justified in treating this estimate as an exaggeration.

The present appearance of the bird in the Firth of Forth—for there is undoubtedly a considerable number of them in these waters—is a good opportunity for watching their movements. Thanks to the Wild Birds Protection Act, the little auk will be safe from the gun in other two days, and it is just possible that some may remain in the vicinity of the Bass Rock. In any case, it will be interesting to note when they leave our waters, and some efforts should be made to trace their movements seawards.

I may add that to the seafaring men of Queensferry and neighbourhood this bird is known as the storm petrel.

[Of the two specimens exhibited, one was from the Firth of Forth at Dalmeny Park, and the other, which was assuming the summer plumage on the breast, was from Loch Screidan, on the west coast of Mull.]

At the meeting of March 27, 1895, papers were read by Mr Hugh Fraser on "Varieties of Heather (Calluna vulgaris)," and by Mr Alex. Campbell on "The Starling."

IX.—*MR G. DON'S SPECIMEN OF HOLY GRASS.*

By The SECRETARY.

(Read April 24, 1895.)

This specimen of the holy grass was found by Mr G. Don in Forfarshire in the beginning of the present century. The discovery of this grass in Britain caused much excitement at the time among botanists, the most eminent of whom declared that the plant was not indigenous to this country. The locality where it was supposed that Don had got it—viz., Glen Cally, in the Clova mountains—had been carefully examined in 1842-43 by the most distinguished botanists, but without success. The plant had been admitted into the

British flora on the authority of Don, but was afterwards placed in the doubtful list, and then dropped out altogether. It was not till 1854, when Robert Dick, the Thurso naturalist, discovered the grass in Caithness, that Don's find was so far corroborated, and the plant readmitted into the British flora. Had Don lived long enough after his discovery, he would have been able to point out the exact spot in Forfarshire where it grew. The locality where Don found the grass has probably not yet been examined. Under Don's specimen is written, "Habitat in Kella valley, Angusshire," and there is a Kelly den or valley on the river Elliot, in the parish of Arbirlot—the most likely spot in Forfarshire in which to find the plant.

At this meeting Professor Heddle, late of St Andrews University, gave a most interesting lecture on "Sand"; and Mrs Carphin read a paper on "The Cricket of the Hearth," with specimens.

EXHIBITS IN NATURAL HISTORY.

THE chief exhibits at the evening meetings during the Session were the following:—

By Mrs Sprague.

"*Jumping Beans*"—fruits of a local Mexican tree, *Sebastiania pavoniana*.

By Mr A. Hogg.

A collection of Golden Eagles', Kites', and Ospreys' Eggs—all Scottish.

By Mr J. A. Johnston.

Pearls from mussels of the river Forth and from other local mussels.

By Mr W. Eagle Clarke, F.L.S.

The Yellow-browed Warbler (*Phylloscopus superciliosus*); and a young specimen of the Hawfinch (*Coccothraustes vulgaris*), bred at Arniston.

By Mr Forgan.

A new apochromatic 4-millimetre objective; and Zeiss's one-tenth apochromatic objective, showing *Pleurosigma angulatum* magnified 1800 times.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Society was held on the evening of October 30, at 20 George Street,—Dr T. B. Sprague, President, in the Chair. The Secretary read the following Report:—

The past Session has been a fairly successful one in the history of the Society. The membership, although far from what it might be, is on the increase, and the meetings have been well attended. The papers read were, with one exception, by members of the Society, and nearly all of them were of local interest. They were 18 in number—15 in the department of Natural History, 2 in Geology, and 1 in Microscopy.

Besides the usual indoor meetings held during the winter, the following 14 excursions were made: Auchencorth Moss, Roslin and Polton, Joppa, Leith Walk Nurseries, Burntisland to Seafield, Blackford Hill and the Braids, Gordon Moss, Dredging excursion on the Forth, Leith to Portobello, East Wemyss to Buckhaven, Arthur's Seat, Falkland Palace and Maspie Den, Davidson's Mains marl-pit, and Duddingston. The average attendance at these excursions was 17—the smallest number being 3 to Gordon Moss, and the highest 53 to Blackford Hill, which was in the evening.

The members of Council who retire at this time are the President, Senior Vice-President, Secretary, Treasurer, Editor of the 'Transactions,' and the four senior ordinary members of Council. The President having intimated that he would not seek re-election, it was recommended that Dr Davies be elected in his stead; that Mr Crawford be elected Senior Vice-President, and Messrs Kilgour and Wright Vice-Presidents; that the Secretary, Treasurer, and Editor of 'Transactions' be re-elected; and Mrs Sprague and Messrs Symington Grieve, Masterton, Gloag, and Wood be elected to fill the vacancies in the Council.

The above recommendation of the Council was unanimously adopted.

The Treasurer then read his annual balance-sheet, which showed a surplus of £18, 2s. 5d. It was also intimated that there had been contributed during the year towards the fund for the publication of the 'Transactions' the sum of £18, 14s.

SESSION 1895-96.

I.—*THE ROLLER.*

BY MR TOM SPEEDY.

(Read Nov. 27, 1895.)

THE bird which I now exhibit is a *rara avis* in this country. In all my peregrinations over Scotland I have never had the pleasure of seeing it. The specimen in question was shot at Swordale in Ross-shire by my friend Mr David Brotherstone on September 30, 1892. It was frequently seen on the public road, the nature of the adjacent ground being whins and heather. It never seemed to be in the company of any other bird. It was observed feeding on the "hips" or seeds of the dog-rose. This observation was strengthened by the excrements, which were of a reddish colour. It frequently perched on a post, but seldom sat any length of time, being evidently restless in its habits. As to how far the shooting of such a stranger can be justified, a considerable diversity of opinion exists. Personally I am opposed to the killing of rare birds, unless for preservation in public museums, in the interests of science. This bird will be presented by its owner to the Museum of Science and Art, Edinburgh.

The Roller (*Coracias garrulus*) is an autumn, or more rarely a spring, visitor to the British Islands. It was first noticed by Sir Thomas Browne in 1644. In proof of its rarity, it may be mentioned that only about a hundred have been recorded since that time. No doubt many will have been observed without being recorded. The origin of the name "roller" is said to be from the rolling of the bird in its flight and its dropping through the air like a tumbler-pigeon. It is regarded by some naturalists as belonging to the class of Corvidæ, and by others to the bee-eating family Meropidæ. I have no desire to detain you with any lengthened observations, more especially as I cannot give you any of my own.

At this meeting Mr A. J. Pressland, B.A., F.R.S.E., read a paper on the "Wild Cattle of Britain," and was awarded a very hearty vote of thanks.

II.—*POISONOUS PLANTS.*

By Mr MARK KING.

(*Read Dec. 23, 1895.*)

There may be a difference of opinion as to the utility of spending much time in the study of the vegetable kingdom, but all should be agreed as to the importance of being at least acquainted with the common plants of one's own country, and especially with those of which man may make use. This is what lately befel a party of New Zealand explorers in consequence of the want of special knowledge. They found themselves one day without food, and with starvation staring them in the face. Searching for some fruit or root with which to appease the pangs of hunger, a new fear suddenly confronted them—a more terrible death by poison. Dragging their wearied limbs along, they reached an encampment of natives, who were roasting some kind of grain among the ashes. Partaking of this, their strength returned, and their lives were saved. The "fruit," on inquiry, proved to be obtained from the cones of the Araucaria Bidwillii, of which vast forests had been traversed by them without a suspicion of its usefulness to them in the circumstances in which they were placed.

At the present day botanists have classified about 100,000 species of herbs, shrubs, and trees, and among this immense number a proportion is more or less deleterious to animal life. For it is a fact that every hedge-bank and pasture in our islands is strewn with poisonous material in abundance. It is safe to say that not a year passes during which some one does not actually meet or narrowly escape death from mistaking a poisonous plant for an innocuous one. Cases of sudden death by poison are more conspicuous and striking in the animal kingdom than among plants, the venom of serpents being a case in point. But virulent poison is also present in the vegetable kingdom. We all know the blister that the stinging hairs of the nettle can raise on some unlucky hand. Venomous plants belong to many different orders, and are found in various parts of the world. Generally speaking, they are widely distributed, being found in all but the most arid or the most frigid of climes. Certain plants possess a special poison apparatus in hairs and bristles, whose points, entering the skin and then breaking, are capable of doing serious bodily harm. The glandular hairs of the common nettle (*Urtica dioica*), which takes its specific name from the male and female flowers growing on separate plants, and of the small nettle (*U. urens*), an annual species, and a troublesome weed on cultivated ground, cause acute pain and irritation of the skin. Yet the power of the British species is feeble compared with that of some Indian forms, whose virulence is said even to cause death.

An example of the danger of poison-hairs is furnished by a recently introduced plant, Primula obconica, a native of China. A market-gardener who grows this plant in quantity, and works the blooms into wreaths, was several times seized with erysipelas, having in all six relapses. His illness was distinctly traceable to the effects of this plant, so that persons susceptible to erysipelas should avoid coming in contact with it. Another case is recorded of a lady, who kept several plants in pots of this primula, having suffered from an acute irritation of the skin all over her hands. On taking away the plants, in a short time the irritation ceased. As the lady rarely touched the plants unless by accident in watering them, obviously to some persons they must emit a poison in a way not easy to explain. Several cases have since occurred which place the irritating properties of this plant beyond a doubt. Unlike the stinging of a nettle, which is evident at the moment of contact, the unpleasant consequences of touching the plant are not felt till some time afterwards, and, instead of soon subsiding, may remain for some days.

The hemp-nettle (*Galeopsis Tetrahit*) possesses a poison equipment which may be described as short and stiff bristles. These, when the plant has come to maturity, are very dangerous. About two years ago a man in the harvest-field received a sting from this plant on the left hand, when symptoms of blood-poisoning soon set in. Medical aid was procured, but was of no avail, and he died in eight days from the time he received the wound. Another case of Galeopsis poisoning came under my notice lately, where a man was punctured on the arm by it. The pain ensuing became so alarming that a medical man had to be called in, and the patient was under treatment for some weeks. *G. versicolor*, a beautiful plant, should be avoided for the same reason.

I shall now notice briefly some posionous plants whose juices from roots or foliage are taken into the human system by the process of mastication. Monk's-hood or Wolf's-bane (*Aconitum Napellus*) is a well-known showy plant belonging to the family Ranunculaceæ. The roots of this species have sometimes been mistaken for horse-radish, with fatal consequences. Two Roman Catholic clergymen lost their lives by eating roots of Monk's-hood in mistake for the latter wholesome condiment. The whole family of the Ranunculaceæ are to be viewed with suspicion. There is a common opinion that cows eat buttercups, and for that reason the butter is yellow. Hence the common name of the plant. This, however, is erroneous. Ranunculus acris, for instance, which abounds in many pastures, is never touched by cattle. There is a popular notion that grazing animals are able to distinguish safe from noxious plants. But if they are transferred to a strange district their instincts fail them. The great spearwort (*Ranunculus Lingua*), the lesser spearwort (*R. Flammula*), and the celery-leaved crowfoot (*R. sceleratus*), I place together, as all three come under the same category. One or other of these forms is believed to have caused the death of horses and cows in Bedfordshire lately, so that farmers suffered considerable pecuniary losses thereby.

Passing to the Leguminosæ, — this order doubtless contributes largely to the sustenance of man and beast, and in it we have many splendid species of both ornament and utility, yet there are among them forms of the most noxious nature. The laburnum, much planted on account of its glossy foliage and pendulous racemes of yellow flowers, is specially to be guarded against. I lately sent the following letter to the 'Scotsman':—

'SIR,—I noticed in your columns of Tuesday the case of a narrow escape from poisoning of five children by eating the seed-pods of laburnum. There are two species of this shrub, or small tree, planted in Britain—Cytisus laburnum and C. alpinus, both poisonous. All parts of the tree—the roots, seeds, and leaves—when taken into the stomach prove a powerful poison. Fifty-eight boys in an industrial school in the south of England chewed varying quantities of the roots of a laburnum tree, mistaking it for stick liquorice. In a very short time the boys were affected with symptoms of narcotic poisoning. They were taken into the infirmary and treated immediately by the application of the proper antidote. It is said that if a garland of the flowers is worn round the neck it produces headache. I recollect an instance of a boy about ten years of age mistaking and eating the seeds for green peas. In a short time he was seized with most alarming symptoms, requiring the immediate attention of a medical man, and it was some time before he was out of danger.

Some other plants of this division have noxious properties attributed to them. Conilla varia, an excluded British species, has poisonous juices; Lathyrus Aphaca, a plant abundant in some parts of England, has seeds which are narcotic, producing headache if eaten in a ripe state.

The Umbelliferæ, a large and well-defined order, contains 1500 species or more. The root, stem, and foliage of some of the species are pervaded with an acrid juice, which renders them extremely poisonous; yet we have in this family many excellent culinary vegetables, such as the carrot, parsley, parsnip, celery, &c. Celery in its wild state is slightly injurious, but when blanched by cultivation it becomes one of the best of salads. Popularly all the tall-growing umbellifers are designated "hemlock," so that it is a difficult task in many cases to trace the particular plant that has done the mischief. Cowbane or water-hemlock, and water-dropwort, both very poisonous plants, when growing near the sea-shore have at times been used as celery by seafaring men, and dangerous results have followed in consequence. The true hemlock (*Conium maculatum*), a widely distributed plant, is well known as a dangerous poison. Three cows, belonging to Messrs Munro, hotel-keepers at Loch Aweside, died from eating the roots of the hemlock, which had been dug out of some waste land in the neighbourhood and cast into heaps along the side of the loch. In October 1894 two boys residing in Greenock, while out in the country walking, dug up some roots of hemlock and ate them. They were shortly afterwards seized with great pain and vomiting, and were removed to the Greenock infirmary, where they were found to be so ill that it was doubtful if they would recover.

That wholesome tuber, the potato, has its share of deleterious properties, although not in the part that is eaten. Its near relation, the bitter-sweet (*Solanum dulcamara*), has scarlet berries, which are poisonous, and children have died from eating them. S. nigrum, an annual, with black berries, is likewise of doubtful character. Even the holly, with its scarlet berries, so closely associated with the festivities of the opening year, is credited with noxious properties. At Chelmsford, a child, after eating twenty or thirty berries, was taken ill, and died. Cattle have been killed by eating the foliage of the yew, another plant used in Christmas decoration. Three heifers were lately found dead on the farm of Pinnaclehill, near Kelso. They were grazing in a field on the farm, and it is supposed that they had been poisoned by eating branches of the yew. In the Court of Session a few years ago a clergyman from Wigtownshire had to pay a considerable sum in damages as the result of a workman stopping up gaps in a hedge with branches of the yew, whereby his neighbours' cattle were killed by browsing on the branches and foliage.

Amidst the large family of the Grasses, of which there are about 4000 different species known to botanists, darnel (*Lolium temulentum*) is one of the very few that are poisonous. This, indeed, has been questioned, as what has not? Sir J. D. Hooker says of it, "Very poisonous"; while Dr Lindley states, "The seeds, mixed with wheat, have killed persons who ate bread prepared from such flour."

I would only remark, in conclusion, that the fact of these poisonous plants growing side by side with others not only harmless, but often serviceable, is a most remarkable phenomenon. What causes them thus to differ from their congeners, growing in the same soil and amid the same surroundings, forms a most interesting subject of inquiry.

III.—*GLACIERS.*

By Mr J. G. GOODCHILD, F.G.S., F.Z.S., Etc.

(*Read Dec. 23, 1895.*)

Mr Goodchild began by reviewing the conditions under which the fall of snow takes place at different altitudes, and made some remarks upon the physical properties of its different forms. The gradation from the various forms of snow into the *névé*, and from this to glacier ice, were noticed in some detail, and were illustrated by lantern-photographs. Median and lateral moraines, crevasses, seracs, glacier-tables, and all the phenomena visible in an ordinary Swiss glacier, were treated in the same manner. Some remarks were then made upon the causes of glacier motion, upon the erosive effects of glaciers, and upon the stony and earthy material carried forward *within* the body of the ice. Photographs of Greenland glaciers were projected by the limelight upon the screen with the object of illustrating these points. Some reference was then made to the results of recent investigations into various glacial phenomena in Alaska, especially in connection with the Muir Glacier. Mr Goodchild pointed out that these results fully confirmed the views regarding the englacial origin of boulder clay, and the formation of kames and eskers in connection with crevasses of melting ice-sheets, which he had been the first to advance, in the 'Geological Magazine' for November 1874, and in the 'Quarterly Journal' of the Geological Society of London early in the following year. The lecture concluded with some references to glacial phenomena in the neighbourhood of Edinburgh.

IV.—*GOSSIP ABOUT GULLS.*

By Mrs JESSIE M. E. SAXBY.

(*Read Jan. 22, 1896.*)

Those of us who are familiar with this interesting family of feathered folk know that they are in the habit of gossiping about us. They discuss us to our faces with as much impudence and penetration as Mark Twain's ravens exhibited when criticising him. Therefore we need have no scruples about retailing what we have seen and heard regarding gulls.

The Shetlanders use the name "scorie" for all gulls except skuas, terns, and kittiwakes; though, when wishing to be more precise, they will tell you of a "white maa" (herring gull), a "blue maa" (common gull), a "saithe gull" (lesser black-back), or a "baagie" (greater black-back). But in ordinary talk they use the term "scorie" precisely as we do that of "gull." "Der wiz a murge o' scories upo' da aire" (there was a multitude of gulls upon the beach). "Da scories wiz clanging i' da bauchs" (the gulls were screaming on the cliffs). "We hae a bonnie peerie aulie scorie" (we have a pretty little pet gull).

My first acquaintance with gulls began with a lesser black-back which had been brought, a baby ball of grey fluff, to our home long before I was old enough to know a bird from a bairn. She was located in our garden, and never cared to leave it even when the gate was left open. One of her wings had been injured at some period, which prevented her from flying; but in spring-time, when her congeners were flocking to the fields close by, following the plough and talking over their nursery preparations going on in the cliffs not far away, then poor Cora grew restless and would scrape out a nest in the garden mould, and would sit on it with a dream of motherhood in her breast. As she grew older she lost this habit. Eggs were once or twice put into the nest, but she always broke and devoured them. Cora was not very amenable to kindness, and would as often as not smite the hand which fed her. While we were small children she obliged us to give her a wide berth, as she would run at us; and many a sharp wound her hooked bill inflicted on little legs. She was as vigilant as any watch-dog. If a hand touched the latch of the garden gate, or creaked it ever so slightly, Cora heard and "gave tongue" by a grave and warning "ko-h-h!" Any food you liked to give her was welcome,—porridge or dry bread, fish, meat, mice, sparrows, or potatoes. She recognised our father, and treated him differently from every one else, permitting him to stroke her, and never attempting to snap at his hand as she did all the others. While he was stroking her and speaking to her, Cora would move round and round, ducking her head in a pleased manner and saying, "Plee! plee!" in the gentle tone which a young scorie uses. That is the first word which a baby gull learns, and it means much the same as the "ma-ma! da-da!" of other biped babies.

Cora feared no foe. Our dogs never ventured inside the garden gate. Prowling cats never got a chance of harrying little nests within those sacred precincts, for though the scorie could not make much of pussy in personal combat, she could give warning of the enemy's presence. Cats have a profound objection to being brought under observation when taking their walks abroad, therefore when Cora's "ko-h-h! kweppapep!" was heard pussy would retire in disgust.

While I was growing up my father interested me with the task of feeding Cora. I honestly tried to make friends with her, but all in vain. Then I grew to dislike her, for I loved that garden as much as she did. It was there I liked to sit and dream, and try to put my dreams into verse. But Cora would hunt me out, and suddenly startle the Muses into silence by a vicious onslaught at my boots and skirts. I would chase her round and round till we were both breathless, but that never cured her. At last I discovered a corner where the wall was easily scaled. The rose-bushes were thickly set around it, and the tangle of honeysuckle twisting about a gracious plane tree concealed the spot from the pathway. The scorie seldom came to that part of the garden. I could get over the wall noiselessly, and there I spent the long hours of many a happy day unbeknown to Cora.

One hard winter when birds were driven desperate by starvation, a pair of hoodie-crows attacked Cora—I suppose to get her dinner for themselves. She was equal to them both, and with voice and beak she gave them battle. My father watched the fight, and was gratified to see the thieves driven off; and Cora, though somewhat ruffled, was able to scream exultantly, "Kya-kya-kya!" which means, "Serve them right, the low thieves! Who's afraid? Well done myself!"

Cora died at the age of twenty-four, which I take for granted is a good age among gulls, for she had begun to develop some of the characteristics of advanced years, as parrots and other birds do.

The sea-mew (herring gull) is the favourite of the tribe. It remains in the Shetland Islands all the year through. It is more gentle and intelligent as a pet-bird than any except the kittiwake. Unfortunately Kitty is one of the mystery-moved creatures that disappear with the summer and come back in spring. I brought a young one with me to Edinburgh some years ago, and in a week it was as tame and affectionate as possible. We fed it on fish and bread soaked in milk, and it seemed thriving and happy enough; but when the autumn set in some heartbreaking vision came to Kitty of far halcyon seas where wings never tire, where suns ever shine, and fresh winds play with sparkling waters all the time. It was a vision as overpowering, as unreasoning, and as incomprehensible as "heimweh," and it killed our kittiwake in a few days. That was the last of many efforts our family had made to win the best affections of a very charming bird. It is true a very few kittiwakes remain over the winter, but they have distinctive marks—a winter dress I suppose—and are believed to be disappointed old maids or sulky bachelors to whom the "vision" is not vouchsafed.

The sea-mew has all the grace, liveliness, and demonstrative ways of the kittiwake, but has much more vigour, and has no migratory instinct. It will eat anything you like to give it. When you have taught it to love you it will make its home with you. No need to clip the sea-mew's lovely wings. Though they carry it afar in search of food and pleasure, they bear it back to nestle by the home it has learned to love.

For close on thirty years a sea-mew was the darling of the old laird, our uncle. Every spring she found a mate, and brought him and the yearly babies to the house. Doubtless her nest was on some cliff not far away, but she evidently looked upon her master's house as home, and when the young ones were off her mind she would return to her wonted habits of appearing under the window at meal-times and of following her special friends around the lawn or farmyard. Her mate often attended her, but he took evidently a second place until spring returned, when, according to Tennyson, the fancy of birds and men "lightly turns to thoughts of love." What became of this dear bird we do not know. What becomes of all the birds who do not fall a prey to a stronger than themselves is one of the unsolved mysteries of Nature. I am fond of imagining that there is an elysium somewhere in the universe where those delightful creatures find endless happiness. If a sparrow falls not to the ground without the knowledge of the All-Father, surely He has prepared a place for all innocent and beautiful beings He has created.

If the Shetlander wished to adopt any emblem for his island-flag he should choose the sea-mew, which adds so much life to the wild rock-scenery, whose fearless, tireless, graceful vitality seems to blend with the life of the islands, making one of its chief characteristics. Flocks of those gulls accompany the fishermen to the haaf and return with them. When weird apparitions appear during some wild storm, or when they are lying by their lines amid the great solemn billows, or when, mist-girdled, they are striving to reach their desired haven by a trackless course, or when their boat is plunging across the "stoing o' the tide," in imminent danger of being overwhelmed —at such times strange revelations come to fishermen, and they usually come in the form of a "white maa." It will hover over the boat, or rest on the bow, or settle on the thwart. And the men know that their visitant is a witch in disguise predicting evil, or a guardian angel bidding them take courage, or the soul of some one beloved coming in familiar form on a mission of love. But the "white maa" does not attend upon man only as a beneficent power. It has constituted itself the vigilant picket of other less wary birds, as well as seals. The sportsman stealing upon his quarry will find himself disappointed if a friendly sea-mew is within hail, for her warning cry will tell the heedless "game" of approaching danger.

When coming down Yell Sound last summer on board the steamer, I saw a pair of "shooies" (Arctic skua gull) tormenting sea-mews after their usual mode. There was a shoal of small fish inshore, and the "maas" were feasting abundantly, but were compelled to pay toll to the winged pirates of their race. One gull, evidently determined not to disgorge, gave his pursuer much trouble by dipping into the sea, and floating on it until driven to take flight by the rapid swooping of the skua, which somehow frightened him as much as the chase on wing had done. At last the skua lost temper, and became bolder. He rose above the sea-mew like a hawk, and coming down in a slanting direction, struck it with his powerful beak. A wild scream, and the poor white maa dropped upon the sea with its delicate plumage stained with blood. There is a limit to what even gulls will endure at the hands of their congeners, and I was much gratified to see that after his furious onslaught upon the white maa a body of gulls rose clamorously on every side, and with bewildering motion and unlimited bad language compelled Master Shooie to depart.

It is very surprising what power of language gulls possess. I have sat in a cleft of the rocks for hours listening to them. Their intonation is wonderfully varied and expressive; so much so, indeed, that the listener can soon understand their tongue, particularly when they are talking about him—or her—self. The way they eye you as they circle past, and remark to a friend on your peculiar habits, is as humiliating to your vanity as an adverse critique on your best book from your favourite newspaper.

I kept a greater black-back in my garden for several years. He was a never-failing source of entertainment. Then I got some fowls and put beside him, and immediately the scorie very affably tried to make friends with the new-comers. But the dignified rooster declined the acquaintance—no doubt suspecting the foreigner of interested motives. That his suspicions were well founded I soon proved. The hens had—as is usual—a little opening in the door of their abode, whereby they could retire into privacy when they purposed laying eggs.

Hens have a foolish feminine habit of "blethering" about every little thing, and the scorie soon learned that when a hen emerged from the door-hole screaming and cackling a nice fresh egg was sure to be inside. He would creep through and seize the dainty. If another hen happened to be inside there would be a rumpus, and the wild cries of scorie for help would bring me to the rescue.

At twilight the hens slowly, one by one, would retire to roost in the hen-house; but Jacob, the patriarchal old rooster, never retired until every one of his household had disappeared. He had to stoop his stately crown to get in at the little hole; and then was scorie's chance of revenging himself for many slights received during the day. When Jacob was half through the gull would seize firmly on his long tail feathers, and then there would be a fine tussle. Not seldom Jacob left a graceful plume in possession of his enemy. I was obliged to fence off a bit of the back-garden and put the gull there, because chickens as well as eggs became his prey. Of course Jacob could have settled all disputes after his own fashion, but I preferred it should be done by my method.

One morning I was waked up by a tremendous noise, and, looking out, saw that scorie had got through the fence, and the whole fowls were on him. He was screaming for dear life and me; they were dancing upon him. Out I rushed in dressing-gown and slippers, and managed to save him, but I almost regretted having done so when I looked round to see a score of bedroom windows in the vicinity with laughing faces at them.

After that Jacob and his numerous family sojourned into Egypt, and scorie was left alone, until a hoodie-crow arrived from Unst, who proved a lively and most entertaining companion. The two became fast friends, though the crow used to play off his jokes upon the gull, tweaking his tail and running after him. The favourite joke was to chase him until scorie got impatient, and opening his mouth screamed, "Kya, kya, kya!" While the throat was distended by that angry expostulation the crow would thrust his beak into it, choking off the curses pouring therefrom, and disgusting scorie beyond the power of speech to express.

I wanted to plant a few flowers in the border, but the crow watched me, and as soon as I departed walked along and pulled up every one; so I shut him into the shed, where he and scorie passed the night. He did not approve of his punishment, and began tapping impatiently on the small sliding panel through which the couple of them went in and out, but which I had closed, of course. The scorie heard and rightly interpreted the "tap, tap." He immediately began to tear away at the panel, shoving his beak under it and trying to lift it. This melted my soul. I bade the flowers look after themselves, and released Master Crow.

I regret to say that a neighbour threw poisoned meat over the wall and killed my poor crow, "because it was not lucky to keep such birds."

The scorie's favourite amusement was catching sparrows. This he did in a very ingenious manner. When food was put out for him he would leave some scattered about. He would stroll around picking up bits of twig and stone, and seemingly quite indifferent to the sparrows watching a chance to feed. When they were at it he would carelessly walk nearer, and then, with a swift dash, fly at and secure an unlucky birdie. A few sharp snaps crushed and killed it, and then it was greedily swallowed. On one occasion I saw him seize a sparrow, and I ran out to rescue it. He had it by the wing,—not, as usual, by the body,—and had not managed to kill it outright, so I was in time to get it from him, to his intense disgust. But after that, if he caught one and the door clicked, he bolted it anyhow, screaming, struggling, wing or tail first, instead of, as formerly, breaking it up and swallowing it head-foremost. As you may suppose, some fun came of this, for even his capacious throat had some difficulty in taking down a live sparrow.

I kept one of the scorie's wings slightly docked to prevent his flying, and he seemed quite contented with his lot. He enjoyed playing in the snow, and would toss it up and tumble about in it; but he evidently did not like cold weather, and if the door were left open would come into the kitchen quite boldly. In frosty weather he suffered from some disease of the throat; it contracted so that he could not swallow, and I had to push food down or he would have starved. He was a bad patient, and I found it no easy job to nurse him, for his sharp beak was always ready. Like Cora, he was a splendid watch-dog, and guarded my little city back-garden as zealously as she had sentinelled the old garden at home. "Wandered" cats and bad boys coming over the wall did not like being "peached" upon if they appeared in sight. Probably the cats talked scandal about scorie when they met on some neighbouring roof, but they never ventured to attack him personally. The boys did, and if their aim had been as sure as their bad feeling, his days had been numbered. I did my best to protect him, but when going abroad I feared for his life; so—with much regret—my scorie and I parted. When I saw him last he was enjoying himself on an artificial lake in Finsbury Park, London; but I was told that a year later he and some others took wing and disappeared. No doubt such creatures prefer freedom with its risks and privations to confinement, even with luxuries attached.

When crossing the Atlantic, I was much interested in the gulls which followed us from Britain and those which met us from America. Our familiar home birds came a long way, at first in great numbers, but day by day less, until not a straggler was to be seen, and I missed their bright noisy presence. When the last of them had vanished I noted one or two gulls hovering about our path quite unlike those which had escorted us from home. The new-comers were almost black on the back, and their wings were not so rounded or so graceful as ours. They were more shy, and almost silent. They had a furtive, almost shrinking, way of hanging around. Their numbers were increased as we proceeded, but I heard none of the interesting talk amongst them which I had been accustomed to hear among gulls. An occasional exclamation from some solitary individual was all. In the Gulf of St Lawrence I recognised some of the old friends of the tribe again, cheery and confident as at home; but they were not in large flocks, and I could not hear of any gullery in that neighbourhood, nor did I see any young scories. It was the same thing on the Pacific coast; there I saw black-backs and other varieties, but no rocks alive with seafowl, as in our Shetland Islands.

In the museums of Montreal and Victoria, Vancouver, were specimens of all our gulls—the aristocratic skua, the stately glaucus, the lovely sea-mew, the common gull, the fairy sea-swallow, and the dear little kittiwake. I was told that these specimens had all been procured in Canada.

When sailing up the Baltic, I was looking for birds, of course, and it astonished me to see so few. I thought that gulls must swarm there, but the number was extremely small. The chief portion of those I saw were not so large as the herring-gull, and were much darker on the back, and their "ways" resembled those of the gulls which met us off the American coast. Of course the sea-mew was to the fore, gay and busy as ever. And another favourite of mine—the Arctic tern—used to visit the ship, coming quite close to me at times, and almost snapping from my hand the bread I was flinging over to them. Clouds of this lovely bird met us in the Cattegat, and followed us to Holland, keeping up a screeching, scolding badinage all the time.

Perhaps the "piccataurie" is the most beautiful of all the family. It yields to none in boldness and intelligence. It is easily tamed, but, like the kittiwake, it "wants away" when autumn brings the yearning and the dream which calls every bird of passage to depart. The Arctic tern is a very social creature, and loves to join a colony of its kind in squatting upon some lonely holm or quiet ness. On such a spot you will find their nests, many and close together, but their womankind have few ideas regarding domestic comfort. They scrape out a tiny hollow, fling carelessly into it a few scraps of weed and grass, and in this primitive cradle is hatched their young. But if the mother piccataurie is careless about the trimmings and cushioning of her basinette, she is not careless of her babies. She will defend them at all hazards. I have heard of groups of terns persecuting, and at last devouring, crows which have dared to attempt stealing an egg or nestling. A touching story was told me of a number of terns surrounding one of their number which had been wounded by a ruthless sportsman. It was floating, unable to fly, on the water, and its companions, screaming their indignation and sorrow in the wildest tones, actually mobbed the murderer, dashing their wings against him, till he was obliged to protect his face with his hand, and make off as speedily as possible. Any inquisitive visitor who may be suspected of similar designs—such as a greater black-back or a raven—will rouse a whole colony of terns into active hostility. By their bold and bewilderingly sudden action they will knock the audacity out of the fiercest robber on wings. We used to look out for the terns in spring, and it was a joy indeed when on swallow wings this fairy cloud of sea-birds returned to us, speaking cheerily of bright days in store. They prolong the happy hours of courtship beyond what any more sober-minded gull considers proper, and they do not settle down to matrimony and its cares till midsummer, when all their cousins have been at housekeeping for some time. Somehow, things turn out as well for the happy-go-lucky piccatauries as for others. Their babies grow up very fast, and are off on their "own hook" long before the older and more dependent scories have ceased to run after their mammies crying "plee! plee!"

I ought not to finish this gossip without reference to the glaucus or Iceland gull, which my father had the honour of introducing to the world as a British bird. He is a large and lordly bird, of equable disposition, retiring habits, and impressive personality. He does not often permit himself to be made the object of close scrutiny. He holds aloof from the other orders of his family, but is affable enough to his own blood relations.

As the glaucus does not often visit Shetland for the same reason that other sea-birds visit it—no nest or fledgling of his having been found there—I imagine he comes from Iceland in the character of an explorer or scientist. He is not on Viking deeds intent—that profession belongs to his cousin, the skua, who is the *beau-idéal* of an old Norse rover. Some people think that the glaucus is a stupid bird, but there is no ground for such a theory beyond the fact that he is not suspicious, looking for a foe in every being he sees, and he is not a bully. He goes his own way and meddles with no one; he is not talkative or demonstrative, but quite willing to dwell in peace with whoever crosses his path. Our brother tried to tame a glaucus, but he was a mature bird, and resented being trapped. Possibly if one could procure a young glaucus before it leaves the nest it would become as tame as any of its genus.

There is a general idea that gulls are—on the whole—stupid birds. So far has this belief gone, that we have coined a word to express the extreme of credulous simplicity; but, as far as my experience goes, I can assure you that a gull is not gullible. If you tell a man a deliberate lie, and he has no opportunity for discovering that you are an untruthful person, is he to be blamed for accepting your statement? Is his intelligence to be doubted because, honest himself, he expects you to be so too? And it is just the same with gulls.

At this meeting Prof. W. I. Macadam gave an interesting lecture on "The Antiquities of the Islands of Seil and Luing, and of the Garve Islands," illustrating his subject by a number of lantern slides.

V.—*POPULAR DELUSIONS IN NATURAL HISTORY.*

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(*Read Feb. 26, 1896.*)

I fear I must begin by apologising to you for choosing so trivial and childish a subject on which to address you; for in speaking to an assemblage of Field Naturalists on such a topic it is scarcely possible that I should have anything new to lay before you, or indeed that I should be able to place in a new light any of the matters of which I propose to treat. The whole range of the subject must be already familiar to you, and there can scarcely be an instance of a popular belief, either proved or presumed to be a delusion, with which you are not previously acquainted.

Therefore I must crave your kind indulgence in endeavouring to pass in review before you this evening some of the numerous instances of the unceasing conflict between ignorance and knowledge, between ready credulity and trained accuracy, as well as of the difficulty in reconciling the credibility of well-meaning witnesses with that tendency to scepticism which grows with scientific education and scientific mode of thought.

A popular delusion is a belief, widely spread among people of a certain stage of scientific education, in a supposed fact which, however the belief may have arisen, is proved by accurate information to be not a fact. Other beliefs, again, may be only reputed popular delusions, because they are so inconsistent with actual knowledge that the trained scientific mind cannot possibly accept them. As an example of the first, we may instance the belief, not yet extinct even among educated people, that as a memento of the peculiar method in which Eve was called into existence, a man has one rib less than a woman. Here the simple process of counting the ribs in a male skeleton settles the matter at once in favour of the sceptical scientist. As an example of the second, we may take the repeated occurrence of live frogs and toads in the centre of blocks of stone,—a belief which we shall see further on is so absolutely and ludicrously opposed to all that we know both of the physiology of the Amphibia or of the geological formation of the earth's crust, that we are compelled simply to say, "We don't believe it."

In dealing with alleged phenomena which are at the same time avowedly natural, a popular delusion essentially differs from a superstition, into which the element of the supernatural, or at least of the "uncanny," always enters. As being on the border line, I may, however, instance the idea prevalent in some parts of the country that a shrew-mouse dies if it attempts to cross a road. But, of course, beliefs in fairies, witches, ghosts, wraiths, unlucky things, &c., &c., however widely spread, are absolutely removed from the category of delusions with which we are this evening to deal.

Also, in being not only widely spread, but more or less self-contained, and chiefly the result of ignorance or of imperfect and untrained powers of observation, a popular delusion differs completely from what is called a "fad." A fad is an erroneous view or theory, typically the property of a few, and these not always of the most uneducated, which owes its origin to an undue bias of the mind on some particular subject, by which the efficacy of the reasoning powers as to matters connected therewith becomes seriously impaired, while the most obvious facts may in consequence become inconceivably distorted in the mind of the individual so affected. It is dangerous to talk of fads, as there is scarcely one of us that has not his own little weakness in this direction, so one instance may suffice. Many well-meaning people may come to have their minds so seriously biassed as to the supposed moral wrong of taking away life in animals, that they actually come to believe and to preach that the use of animal food is the one great cause of nearly all the evil passions as well as most of the bodily diseases to which frail humanity is subject!

Popular delusions on matters of Natural History have been, and are still, so extremely numerous, that we can only deal this evening with a few selected cases. They are not confined to any particular class or order of animals, but the Vertebrata certainly furnish us with by far the greater number of examples.

As to the Invertebrata, we need only mention the case of evolution extraordinary which is, by the common people in many parts of the country, thought to take place when a horse-hair is left in a stream or lake for a little while. It assumes life, begins to move and to swim about, and finally it evolves into an eel. This is surely more remarkable than the evolution of man from a pithecoid ancestor! The origin of this idea has long been settled as attributable to the Gordius aquaticus, a long, slender, almost hair-like worm which lives part of its life in water, part as an internal parasite in the bodies of insects. Here we have, in the first place, a case of faulty observation in mistaking a worm for a horse-hair; in the second, the utterly unwarrantable supposition that this moving hair-like body afterwards becomes an eel; thirdly, the conversion of this fancy into a supposed actual fact, and its being spread about from mouth to mouth and generation to generation as an accepted popular belief. This is a typical case of a popular delusion.

We may allow this example to stand for the Fishes as well as for the Invertebrata, and pass to the Amphibia, concerning which there were, and to some extent still are, some strange delusions current among the people. The case of the frogs and toads supposed to be found alive in the interior of blocks of stone we shall consider under the head of Geology; here we shall confine ourselves to the Urodeles or long-tailed Amphibia. The water-newts, or asks, poor things, have long been supposed to be poisonous, but the most remarkable thing with which they have been credited is getting into the human stomach by being drunk in a draught of water, and, once in, setting themselves up as internal parasites, and having a good time at the expense of the unfortunate host. Some years ago, indeed, I remember seeing a case quoted from an American paper of a woman who was for some time troubled with an unpleasant guest of this sort. The great interest lies, however, in how to dislodge him; and the method advised in the part of the country where I was born is, I see, quite the same as that which Mr Frank Buckland, in his 'Curiosities of Natural History,' mentions as having been had recourse to in Lancashire. The patient was to eat very salt food and drink no water, and then go and lie down beside a running stream with his mouth open, when the ask, tormented by thirst, would crawl up his throat and run down to the water to drink. Then was the time to seize him and kill him.

Passing now to the class Reptilia, we find of course many curious ideas concerning snakes and snake-like forms. Every one knows that the harmless snake-like lizard of our own country, generally known as the blind-worm (*Anguis fragilis*), is subjected to ceaseless persecution by the country people under the fixed delusion that it is poisonous like an adder. But one of the most extraordinary myths regarding animals is that of the American "joint-snake," usually supposed to be the *Ophisaurus ventralis*, or glass-snake—a footless lizard allied to our blind-worm. It is now a good many years ago since a gentleman speaking with a strong American accent called on me at the Museum, and after telling me that he had been much pleased with our collections, and that he would be glad to help us by sending specimens of Natural History from Florida, in which state he was an orange-planter—"Ah," said he, "I know what would please you; you would like to have a *joint-snake!*" Then he proceeded to give me a full account of this joint-snake, describing it as a snake which, if struck with a stick, divided into six or seven pieces. If the pieces were now allowed to lie on the ground without further disturbance, in a few minutes the piece fitting on behind the head-piece would wriggle up to its place and join on, and so would all the other pieces in due and proper succession until the tail finally adjusted itself, when the now recompleted joint-snake would dart off into the bushes not a whit the worse. He also told me of a man who had experimented by lifting up one of the pieces, but the joint-snake had no idea of going off with a segment missing from the middle of his body. The pieces joined together all right till the place was reached where the missing one should come in, when the process of reconstruction absolutely stopped.

"And have you ever seen this?" I inquired.

"Certainly, sir, I have," he replied. Then he gave me a most graphic account of how he and his brother were walking one day in the orange-plantation when a joint-snake made its appearance on their path, and the opportunity of making so interesting an experiment was at once seized upon. The poor creature was at once beaten into pieces; but in a few minutes all the pieces were reunited and the snake went off on its way rejoicing, as if nothing at all unpleasant had happened.

"I suppose," he concluded, "you will not consider this credible?"

"Well," I replied, "all I can say is that it is contrary to all the results of experience."

Was this gentleman a deliberate liar or not? I really cannot undertake to say. He left me his name and address, and also solemnly promised to send me a "joint-snake" in a box; but it has not arrived to this day. But I have since found that the myth of the joint-snake is a matter of popular belief in the United States, and in fact a few years ago my children, to whom I had told the Yankee tale to amuse them, pointed out to me an article in 'Harper's Young People' in which the legend of the joint-snake was related apparently as an actual fact! That is, I suppose, scientific education for the young!!

We next come to the true snakes or Ophidia, and here a very old and widespread belief arrests our attention. The belief in question is that young adders are in the habit of creeping down the throat of the mother in case of surprise or danger. This belief is said to be as old as the time of Queen Elizabeth, but it has recently blossomed out again in a most vigorous manner, and a great deal has been written about it last year in the sporting papers, such as the 'Field' and 'Rod and Gun,' and also in 'Natural Science.' Mr Tootal Broadhurst of Terregles, Dumfries, has also issued a pamphlet containing a large number of reprints of letters addressed to these papers, written during the past two or three years by people who emphatically declare that they have witnessed the occurrence. Of these Mr Broadhurst is himself one, and he reprints a letter written by himself to the editor of 'Rod and Gun' (June 17, 1890), which we may quote:—

Sir,—When shooting on the High Moor at Springkell, Dumfriesshire, some years ago, I came upon a viper basking in the sun with her young ones, I think six or seven in number. As they were not disturbed at my approach, I watched them for some little time and called my keeper to see them. They were disturbed by my calling to the man, and I distinctly saw all the young ones run to the old viper, enter her mouth, and entirely disappear inside her. I was standing a very few yards—my impression is, not further than three or four yards—away, and could see everything clearly. I killed the old viper with a stick, and in doing so she burst, and out of the burst came all the little vipers, which I also killed. The keeper who was with me at the time is still in my service, and can confirm what I have said.—H. Tootal Broadhurst.

Then follows a whole host of letters, most of the writers of which affirm in the most absolute and positive manner that they have seen the young adders either going into or coming out of the mouth of the parent, or both; though one writer guards himself by saying that "we both distinctly saw, or *believed* we saw," some young ones go into the mouth of the mother.

Nevertheless, in spite of these absolute and positive assertions made by people of whose truthfulness we cannot entertain a doubt, men of science remain still sceptical. Why do we not believe those good people when they tell us that they have actually seen the young adders enter the mouth of the old one? Simply because, as in the case of the joint-snake, the phenomenon is so contrary to experience—in other words, so improbable—that we must have evidence of a much more decisive character than the statements of non-scientific eye-witnesses. No one has ever secured the snake with its young after they had been swallowed, though rewards have been offered by the 'Field' as well as by Mr Tegetmeier to any one who will do so. It has been objected that the risk of being bitten by the snake while attempting to tie a string round its neck to prevent the young getting out again is sufficient to deter people from trying it; but rattlesnakes, which are far more deadly and dangerous than British vipers, are easily secured in North America by pinning down the neck by a forked stick.

The only evidence at all approaching to scientific evidence is that of Dr Harley of London, who says that "on one occasion, when fishing in the island of Arran, I suddenly heard children shouting as if in fear, and on inquiry found that they had surprised an adder with a lot of young ones beside her, and that the mother had opened her mouth and the young ones had jumped down her throat." He then goes on to relate that finding the snake had been killed by the blow of a stone, he took it up and put it in his fishing-basket. On the road, moved by curiosity, he took out the snake and opened it with his pocket-knife, when he found within the body of the parent "nine lovely, glistening, scaled young adders, as neatly and closely packed together as if they had been so placed by an experienced hand." Further he tells us that "each was neatly coiled into a perfect but elongated figure of eight, the heads and tails meeting at the central twist of their bodies."

Dr Harley, perfectly confident that the young adders had been swallowed, now asks, In what part of the mother's body were they? In the stomach, or in the oviduct? He decides that they were in neither. "There was not the slightest doubt," he says, "that they had been swallowed; while the fact of their having been swallowed in the presence of danger showed that the mother did it with the object of protecting them, and not with the object of making a meal of them." Then he argues that they could not be in the stomach, as living tissues could no more than dead ones resist digestion; furthermore, that they could not live there, as, being air-breathing animals, they could not receive the necessary supply of oxygen! Then having satisfied himself "that snakes do swallow their young, and that the young were not in the stomach," he "left the animal where it was."

That must have happened in the year 1857 (a good long time ago now for the memory of details), for he goes on to tell us that it was not till 1863, six years afterwards, that in dissecting an African puff-adder, which had died in the Zoological Gardens in London, he discovered a part of a snake's body where he fancied "young snakes may not only be received, but kept alive for a considerable time, and afterwards sent forth alive and well." Judging from his description, this supposed discovery apparently resolves itself into his coming upon the posterior non-cellular extremity of the snake's lung, regarding which, as "its walls were composed of fibrous tissue," he "at once saw that there was nothing to prevent its becoming an admirable and comfortable receptacle for a whole brood of young snakes. Unlike a stomach, it contained no irritating gastric juice to injure or digest them; while above all, its free communication with the external air would enable the young snakes to breathe in it as when they were in the open air itself." So he concludes: "After making this discovery I no longer doubted that poisonous snakes swallow their young with the object of protecting them, and can retain them within their own bodies until the danger is passed with perfect impunity."

It is indeed strange that a man who had passed through the scientific training which is inseparable from a medical education, and who, moreover, had attained the fellowship of the Royal Society of London, could write anything so utterly unscientific as the long letter to the 'Field' from which I have just given the above quotations. Note that Dr Harley's entire story rests upon the assertion of some children that *they*, and *not he*, had seen the young adders go down their mother's throat. As he implicitly believed in the truth of this assertion, of course the young adders could not be in the oviduct; and as to the stomach, if they were in the habit of going into the parent's stomach, they would be digested or suffocated. Then, with the point of location still unsettled, he actually cares so little about the matter as to leave the dead snake lying on the roadside. Then about six years afterwards he comes upon the non-cellular air-sac at the extremity of a snake's lung, which, without any evidence, he assumes to have been the place into which the young snakes are received. And finally, more than thirty years afterwards he dishes up this chain of assumptions as evidence that the popular belief as to snakes swallowing their young is true!

That the young snakes disclosed in the body of the parent by Dr Harley's pocket-knife were contained in the oviduct is by far the most probable explanation of his finding them, and consequently, instead of having been swallowed, they had, in fact, never been born! For it must be noted that the adder does not, like the harmless ringed-snake, lay eggs, but brings forth its young alive, and I am certainly inclined to believe that the origin of the whole myth is to be found in the escape of young adders from the bodies of pregnant females when beaten or burst open by blows of sticks. Regarding this, Bell remarks in his 'History of British Reptiles': "If a female viper about to bring forth her young be killed, and the young ones set at liberty by opening the abdomen, they will immediately crawl about, and on being irritated will throw themselves into attitudes of defence." And as regards the repeated assertions of those who declare that they have seen the swallowing process taking place, I fear we must remain sceptics until reliable scientific proof has been obtained of the fact, even in spite of the vigorous protests of gentlemen like Mr St Croix Rose, who indignantly declare that the evidence of their eyes is "somewhat stronger than the opinion of all the scientists in the world who may allege that it is improbable or impossible because it has not been proved anatomically."

Before leaving the subject of Reptiles some might expect that I should enter into the question of the "great sea serpent." This is, however, a subject of much too great extent to discuss on the present occasion, and, moreover, I hardly think that its consideration is included in the scope of the present communication, and I must content myself with briefly expressing my own private feelings about the matter. An eminent naturalist is reported to have said that if some one told him that a centaur had been seen walking along Piccadilly, he would not believe it until he himself saw the said centaur lying on the dissecting-table ready for anatomical examination. So in like manner, in spite of all the assertions, affirmations, affidavits, and declarations of fishermen, seamen, naval officers, and others who maintain that they have seen this sea serpent, I fear I must remain sceptical as to its existence until one shall be caught or thrown ashore, or bones or other remains reasonably attributable to it be dredged up from the bed of the ocean. Meanwhile I shall just briefly recall to your minds one well-known instance of a remarkable sea monster which actually was washed ashore at Stronsa in Orkney in the year 1808, to show the utter unreliability of many of the accounts given by ordinary people of things which they have seen or profess to have seen. This creature was said to have been 56 feet in length, and numerous affidavits were taken as to its appearance when found; also a drawing was made from these descriptions which the describers agreed was a pretty correct likeness of what they had seen. These affidavits along with the drawing were published in the second volume of the Wernerian Society's Transactions, and represent to us an elongated lizard-like monster with a small head, a long neck, a mane of erect bristles extending along its back, and, most remarkable of all, no less than three pairs of legs with feet! Fortunately some of the vertebræ of this great sea serpent were preserved and sent to the University of Edinburgh. They turned out to belong to the basking shark, which does not reach a length of 56 feet, which is not a creature of slender build, which has not a long neck nor any mane along its back, and which of course has no feet at all, but fins.

Going on now to Birds, we may pass over the old and bizarre idea narrated as actual fact by Hector Boece and other authors, that barnacles, which we now know to be crustaceans, grew on trees by the seashore, and that out of them were produced actual geese; a myth which no doubt had its orgin in waterlogged pieces of wood—fragments of shipwrecks — being thrown ashore with barnacles adhering to them, and in the tentacles (= crustacean feet) of the barnacle having a somewhat rude resemblance to the feet of a bird. It is indeed curious that the breeding haunts of the goose called specially the Barnacle Goose, which is not a common winter visitant to our shores, have never yet been discovered, though they are said to have produced eggs in confinement.

In former times, when the migration of birds was not understood as it is now, people had to account for the disappearance of the swallows during winter, and what could be a more natural supposition than that they passed the cold season of the year in a state of hibernation. As far back as the time of Pliny they were supposed to become torpid in recesses of rocks and mountains, in old towers, under thatched eaves of houses, in hollow trees, and many other similar places, whence they issued on the arrival of the mild breeze of spring. But still more wonderful — they were actually believed to become torpid under water, and to remain during the winter at the bottoms of lakes and pools. Of course in old records we find the same tale as that to which we are so well accustomed — stories, declarations, affidavits, and sworn statements of people who had seen, or maintained they had seen, swallows taken out of holes and other places, even out of water, and which after being placed before a fire revived and flew away!

Yet there are not many people who believe such tales nowadays. Birds with their hot blood and rapid circulation one would naturally think to be hardly the best subjects for hibernation; but their powers of flight have given such of them whose constitutions require a change in winter the means of removal to more genial climes, which is denied to poor creatures like dormice and hedgehogs. Nevertheless the belief is not extinct—the inevitable letters occasionally appear in the 'Field' telling of swallows that have been found in winter-time or early spring asleep in hollow trees and crevices in cliffs and such places. And the belief has been recently defended by Mr Charles Dixon in a book on the migration of birds, published in 1892, in which, though he rejects as impossible the idea of swallows sleeping during winter under water, he shows a decided tendency to look tenderly on the view that they may hibernate in other situations. The interesting point is that he quotes the opinion of the American ornithologist, Coues, that the American chimney swift (*Chætura pelagica*) hibernates in hollow trees, because that species is not known to winter out of the United States, nor is it found anywhere in them at that season. But as this species has been found in Mexico and Central America, the supposition—a mere hypothesis at the best—can hardly be said to have any support whatever.

Want of time prevents us from paying any attention this evening to popular delusions regarding Mammals, so we may now pass on to the next subject.

We now proceed to the subject of Geology, and here we find that the strangest and most erroneous ideas are prevalent even in the most highly educated ranks of society. This is due to the deplorable fact that in spite of all our geological societies, geological text-books, popular works, and popular lectures,—in spite of all the controversies which have raged about the reconciliation of the facts of Geology with the account of the creation of the world given in the first chapter of Genesis,—very few people outside the narrow limits of those who are themselves either professional or amateur geologists seem to know anything whatever of the teachings of geological science. I think that most educated persons would feel ashamed of themselves if it came out that they were ignorant of the fact that the blood circulated or that the brain is the organ of mind. Or to take Astronomy, if they did not know such elementary facts as that the earth and the other planets move round the sun, or that an eclipse of the last-named luminary is caused by the moon getting between it and the earth. But as regards Geology, people are not at all ashamed to grow up and pass through the world without knowing even the merest elements of the science, and come in consequence to entertain the haziest and most erroneous ideas regarding geological phenomena—ideas which, owing to their widespread occurrence, may properly be classed as popular delusions.

Sir Henry Howarth, in a recent paper on Geological Museums contributed to 'Natural Science,' relates an amusing anecdote which puts the whole case before us at a glance. "A young American lady who was looking through the Museum at Lincoln the other day asked my friend Canon Nelson what certain curious-looking stones were. He explained that they were fossils. 'And what are fossils?' she asked. 'The remains of animals and plants which lived a very long time ago and are now preserved in stone,' said he. 'Have you no fossils in America?' 'Oh no,' she replied, 'America is such a *new* country'!"

You will find that people in general have no idea whatever of the formation of rocks—of geological time divisible into successive epochs characterised by different assemblages of animals and plants which successively died out to be followed by others—or indeed that land and water have ever changed places. If they have heard of fossils at all, or if they have even seen such things, they have as little knowledge as to how they got into the stones as a certain eminent person is said to have had as to how the apples got into a dumpling. I rather think you will find that a very common idea is that they have got pressed into the stones from the outside in a way which no one, not even themselves, can understand. As an instance of this, I remember that some years ago an article upon Caithness was published in a London newspaper, in which the writer takes the opportunity of mentioning the fossil fishes, which we all know are so abundant in the Old Red Sandstone beds of that county, and in doing so he refers to the shoals of fishes which in former times frequented the coasts of Caithness, and whose bones have "penetrated the rocks"!! Note the idea not only of the penetration of the rocks by the bones of the fishes, but also of there being coasts of Caithness, as we now understand them, at the time when the Old Red Sandstone was being deposited under water. Another delicious instance came to my knowledge of the editor of a fishing paper who wanted some one to write an article on "How to find Fossil Fishes," because the readers of his paper had "exceptional facilities for getting at all parts of a rocky stream," and that they might in fact "fish in a double sense,"—thereby clearly indicating that he imagined that the fossil fish which his anglers were to find had been inhabitants of the same stream, and had some way or other got baked into the stones in their rocky beds!

In like manner the absolute lack of knowledge of geological time, or of successive geological and palæontological epochs, conduces to a general ignorance of the fact that fossil animals and plants, excepting those of the most superficial formations, belong to species, often to families and groups, which have long disappeared from the ranks of living forms. How often, when showing to friends a fossil fish from the now inconceivably remote Devonian or Carboniferous periods, have I been assailed by the question, "And do you know what kind of fish it is?—is it a perch, do you think?" That the fishes of the Old Red Sandstone lived and moved and had their being at a time when the perch of our modern lakes was a thing of the far-distant future is an idea which never apparently has been presented to their minds.

But there are plenty of people who have heard in a general way of extinct animals,—great "dragons of the prime," *Ichthyosauri*, *Plesiosauri*, mammoths, mastodons, and so forth; but the total want of conception of geological time to which I have above alluded leads to the delusion that all those were contemporaneous with early man—a delusion no doubt partly derived from the old idea which prevailed before Geology became a science, that fossils are the remains of the creatures which perished in the Noachian Deluge. You may often, indeed, in newspaper notices see the term "prehistoric" applied to fossils of palæozoic times, as if they belonged to the same category of things as the celts and flint arrow-heads of the early human period. And in a set of amusing drawings recently published in 'Punch' under the name of "Prehistoric Peeps" you will see our supposed primitive ancestors disporting themselves in the company not only of mammoths, but mesozoic reptiles which were extinct countless ages before man appeared on the world at all. It is true that many extinct mammals of the Quaternary period, which geologically speaking is but as yesterday, were contemporaneous with early man,—but not the reptiles of the Lias or Wealden! Possibly the artist who drew these pictures was not ignorant of the difference in geological age between a mammoth and an *Iguanodon*, and meant the whole thing for a joke, which my obtuse northern head fails to appreciate, and it might be asked, Is it not equally legitimate caricature to represent a primeval savage encountering a Liassic reptile as playing at billiards or riding in a hansom? Or was John Leech in the wrong when in the 'Comic History of Rome' he represented the Sabine women in the costume of Englishwomen of the middle of the present century, or depicted Mars courting the Vestal Virgin in the uniform of a smart British Life-guardsman? No; in the latter case we have simply ludicrous incongruities which every one understands; in the former we have absolute untruth, which is not real caricature, and which, besides, serves to continue and to propagate erroneous delusions in the minds of the people as to matters of fact.

Coming up a little higher in the scale of popular education and intelligence, there is one interesting delusion with regard to matters palæontological to which I would direct your attention for a few moments,—a delusion which owes its origin, I am afraid, to a saying of the renowned Cuvier himself. It is to this effect, that a skilful and practical comparative anatomist may from the examination of a single bone of an extinct vertebrate animal reconstruct the skeleton of the entire creature. It is true that from a single bone, or from a few bones, we may often learn much regarding the affinities of the animal concerned, but reconstruct it—no, not until we have got the whole or nearly the whole of its skeleton together. It is only necessary to point to a couple of the remarkable blunders which have been made in the way of restoration of extinct animals from insufficient material. Before the skeleton of *Iguanodon*, the huge herbivorous reptile of the Wealden, was thoroughly known, Mr Waterhouse Hawkins constructed a "restoration" of it, which is, I believe, still to be seen in the gardens of the Crystal Palace at Sydenham, in which it was represented as an animal walking on all fours with nearly equal legs, and with a horn in its nose like a rhinoceros. Absolutely complete skeletons of *Iguanodon* have, however, since turned up in the Wealden of Belgium, which show that, reptile as it was, it had a figure not unlike that of a huge kangaroo with comparatively small fore-limbs, and enormous hind ones, upon which it must in all probability have been in the habit of standing. As for its horn, it possessed no such ornament, Mr Hawkins having placed upon its forehead the terminal joint or claw of one of its digits!

It may, however, be said that Hawkins was not a man of very high position in the scientific world; but the same cannot be averred regarding the late Sir Richard Owen, who may be said to have been the most eminent comparative anatomist after the time of Cuvier. Because he found that the skull of the large Triassic *Labyrinthodon*, in which he included *Mastodonsaurus* of Jaeger, was amphibian in its character, he rushed to the conclusion that the animal was frog-like in its form; and rushing also to the conclusion that certain footprints, also Triassic, known as *Cheirotherium*, were made by the same or similar creatures, he actually produced a sketch showing a *frog* of gigantic proportions coolly walking along the sand and imprinting the said footprints on its way. And the result was that the whole group of Labyrinthodontia were afterwards proved to have long tails like newts or salamanders, and so to be quite unlike frogs in shape, while as to the footprints there seems to be a strong probability that they are dinotherian and not amphibian in their origin, as was formerly supposed.

The mention of frogs now leads up to the last popular delusion which I shall mention to-night, and it is certainly one of the most remarkable, widely spread, as well as persistent, in the whole set. I refer to the reported occurrence of living frogs and toads enclosed in blocks of rock or stone, or in the boulder clay many feet below the surface of the ground, which is not much better. I remember being told of such occurrences when I was a mere child, but experiments were being made long before I was born to test their possibility. How far the belief goes back into past time I do not know—certainly it is far from extinct at the present moment.

These tales generally originate with ignorant workmen, but they are nevertheless often believed in by people of high education. It is scarcely eight years ago since the late Miss Amelia B. Edwards, the eminent Egyptologist, wrote to the 'Times' a letter concerning the finding of a live toad deep down in the boulder clay at Greenock; and I myself once came very near giving offence to an accomplished writer by venturing to doubt the occurrence of live frogs in the Old Red Sandstone of the north of Scotland.

Such assertions are often made just about as positively and emphatically as those about vipers swallowing their young, or the appearance of the great sea serpent. Let us take a couple of examples.

In the nineteenth volume of the 'American Journal of Science' you will find a short notice of such an occurrence by Mr David Thomas, evidently a believer in the facts he related. In the year 1822, during the excavation for the Erie Canal, some of the limestone taken out at Lockport was being made into jambs when a live toad was found inside one of the blocks by John Jennings, described as "a man of unimpeachable veracity." Mr Thomas then quotes from a letter written by Mr Boughton, afterwards a member of the Senate:—

> The stone had been marked out for the jamb, and on breaking it to the line it broke through the centre of the cavity, leaving about half in the face of the jamb. The toad, which was represented to be of the small brown kind, fell out, and after jumping two or three times (not more) expired. I passed along a few minutes after, and had the relation from Jennings, but did not see the toad. He said some Irish labourers came along just at that time and took it away with them. Jennings was directed not to work the cavity out, and it stood for years in our counting-room, where you may remember to have seen it. From the cavity to the outer edge of the stone at its nearest part was probably 3 or 4 inches, and was perfectly solid all round. I never doubted the correctness of Jennings' statement. All the circumstances seemed to confirm it.

What can our sceptics say in the face of this most circumstantial account and the unimpeachable veracity of the workman Jennings?

Let us take another example. In Stuart's 'Lays of the Deer-Forests' mention is made of a notice published in the 'Globe' of August 17, 1846, of a live toad found in the centre of a block of blackband ironstone in Ayrshire, and the authors then proceed to quote the following account which they received from the manager of the ironworks:—

> On the 31st of July two men, John Black of Little Bigg, Auchenleck, and James M'Kee, of Cumnock, both quarrymen in the employment of Mr M'Turc, ironstone contractor to the Lugar Iron Company, were raising ironstone in an open-cast working in Belton Mill Holm, on the banks of Lugar Water. These men having loosened a block of ironstone of the carboniferous kind, 5 feet or thereabouts in length, and nearly 2 feet in thickness, were in the act of breaking it up when one of the fractures crossing a little hole in the apparently solid stone; from this hole a live toad crept out and was taken up by M'Kee, who showed it to his neighbour and also to about a dozen men working in the quarry. After having satisfied themselves that it was a toad, though small in size, being somewhat less than a hazel nut, they let it go, when it leaped off and made its way to a pool of water on the face of the working. On reaching the water, which might be about 4 feet deep, it struck out quite lively, and in a few strokes was out of sight.

Records of this kind, chiefly taken from newspapers, might be multiplied without end were it worth while; it is indeed only a few months ago since a case was narrated in the 'Newcastle Chronicle.' I shall only further allude to a particularly amusing "newspaper scrap" which the late Mr Frank Buckland tells us he found among some of his father's notes. Here the writer, after relating the finding of a live frog by two miners in a block of coal in a pit near Bathgate, informs us that "it inspires us with a kind of fear to be brought into contact with a living being that has in all probability breathed the same air as Noah, or disported in the same limpid stream in which Adam bathed his sturdy limbs."

I daresay you have all heard of the late Dean Buckland's experiments, made with the purpose of ascertaining how long toads and frogs could live shut up in cavities of stone and excluded from air and food, with the result that most of them were dead within a year, and none survived more than two. The worthy Dean, who of course could not believe such nonsense as that presented to us in the usual stories, was inclined to seek for an explanation of the popular belief as to this matter by supposing that a frog or toad when very young and small might creep through a crevice into a cavity of the rock, and finding food in insects, which might also creep into the same hole for shelter, might increase in size, and ultimately grow too big to get out by the same way as it got in, and so might be found by the quarryman or miner, who would in all probability overlook the existence of the supposed passage of entry.

For my own part, I have not the slightest doubt that the real explanation of these alleged occurrences of frogs and toads enclosed in stone is simply the habit of rushing at conclusions, combined with the want of power of accurate observation, which so eminently characterises the uneducated mind. A stone is being broken, a frog is seen hopping about close to the place, and forthwith the lively imagination of the quarryman persuades him that he has seen it actually come out of a cavity in the rock.

It only remains to be said that there is no example of such occurrences attested by evidence which the scientifically-trained mind could possibly accept as really authentic. But that there are still educated people who can believe in such things is of course another evidence of that utter and crass ignorance of the merest rudiments of Geology to which I have already referred. Fancy a piece of blackband ironstone deposited under water in the remote Carboniferous period, millions of years before the animals and plants which we now see around us had come into existence — covered up under hundreds, perhaps thousands, of feet of superincumbent strata — subjected to a pressure which has in most cases crushed the real fossils it contains as flat as paper, and yet containing a live frog or toad belonging to a species alive at the present day! There are, I believe, some theologians, litterateurs, and art critics who dislike science. Well, then, they should really get hold of a true and authentic case of a live frog inside a block of stone; for the blow of the hammer that disclosed that frog would at the same time destroy not only Geology, but all science with it, and then we should be again brought back to a blessed and undisturbed medievalism. Of such a consummation I, however, see at present no prospect.

Some may say that Science is like Mephistopheles, who, when Faust asked him who he was, replied, "Ich bin der Geist der stets verneint." But Science affirms as well as denies, and her denials are like the negative pole of a magnet, which as a matter of course presupposes the positive as well.

Popular delusions, then, seem to owe their origin to two different causes—first, to simple ignorance, which leads people to adopt erroneous ideas regarding certain things, or to devise erroneous explanations of natural phenomena; secondly, to imperfect and hasty observation, which, supplemented by subsequent involuntary mental exaggeration or distortion, leads individuals to firmly believe that they have actually seen things which in reality they have not seen. And we may, indeed, have both causes combined in the production of beliefs which in the process of time become firmly established among large sections of the people. It is certainly a strange, if unwelcome, conclusion to which we are obliged to come, that the accounts given by persons of untrained observational powers as to what they profess to have seen are simply not to be trusted, even though they may have no desire to deceive, and may be, like John Jennings who found the toad in the block of limestone at Lockport, persons of "unimpeachable veracity."

It may be said that we are here dealing a fatal blow at the credibility of witnesses in trials before the courts of law, a blow which would shake our social system to the foundation; but it is hardly so bad as that. In big things, things easily observed and appreciated,—such as seeing one man knock another down, or climb over a wall, or pick a pocket,—the evidence of a truthful person will be perfectly trustworthy; but when it comes to other matters requiring special accuracy of eye and memory, the case is altogether different. I should certainly not like to see the issue of a trial, civil or criminal, depend on the question of whether a man had seen the sea serpent, or had witnessed a family of young adders creeping down their mother's throat.

It is really astonishing how inaccurate ordinary educated (not to speak of uneducated) people sometimes can be, when they profess to relate what they themselves have seen, or to recount what they have heard from others. And indeed until accuracy of observation, as well as of narration, is more strictly inculcated as a part of general training than it is at present, outside scientific circles, I fear we must still bear in mind a line of a certain comic song which tells us that

"You must not believe all you hear."

VI.—*NOTES ON MORVERN, ARGYLLSHIRE.*

By Mr CHARLES CAMPBELL.

(*Read Feb. 26, 1896.*)

During the last few years I have spent some time each summer in a secluded corner of Argyllshire, and I venture to lay before the Society some general notes on the Natural History of the place. The district is of course embraced in Mr Harvie-Brown's 'Fauna of Argyll,' but the parish of Morvern is seldom mentioned in that work. It seems to me, however, to be deserving of more attention from naturalists.

Almost an island, it has seaboard on three sides—viz., the Sound of Mull and the waters of Loch Linnhe and Loch Sunart; and it is joined to the mainland only by a narrow neck of land. It is more with the Loch Aline district of Morvern, however, that I am acquainted. After landing at Loch Aline pier, which is the only means of communication with the outside world, I had to journey about three miles inland along the margin of the loch to the hamlet where I lodged. The sides of the loch are steep and woody, the outline being too uniform to admit of any picturesque character, at least toward the town part. But at the upper end it is entirely changed, becoming bold and intricate, and receiving two very romantic streams, which, forcing their tortuous way in deep, rocky, and wooded channels, fall into it at opposite angles. Here at least the loch deserves its name of the "beautiful." Pursuing the course of these two streams, the southern ascends the mountains, amid rocks and woods, and the northern, which is the more important, conducts to a narrow but green and prolonged valley, which leads to a chain of lochs the first of which is Loch Arienas, where the water has its origin. In the river Aline some fine pearls are occasionally to be found. These are got from the fresh-water mussel, which occurs very plentifully in the whole course of the river. When the river is low with the summer droughts, many shells may be gathered from one pool, but the number of pearls to be found in them varies of course with the luck of the individual. To show the abundance of fish in the river, I will just mention one expedition I was at. Serenging, or fishing with the net, is not often practised, but I happened to be on the spot once when the order was given. It was at midnight, and we had to cross the loch in a small boat, which, with the weight of the net and the number of men in it, was uncomfortably near the surface of the water. In crossing, I had a fine opportunity of witnessing the occurrence of the phosphorescence occasionally to be seen here. At every dip of the oar the water dropped in sparkling gems, and a stream of dancing light followed in the wake of the boat. It was like sailing in a sea of fire. When the net had been circled out we soon had evidence of a good haul. Careful manipulation by experienced hands soon had 220 sea-trout, ranging from half a pound to 5 lb., lying on the beach. A beautiful sight they were, as they lay on the shingle, glistening in the early morning light. In case any should exclaim against this seeming unsportsman-like capture, I may say that, with the exception of a very few, the whole of the fish were divided among the workmen of the estate. That the river did not suffer in any way from the haul, I had ample evidence during the next few weeks; but as the fishing is on a private estate, and strictly preserved, I will not dilate on its excellence.

To turn to other subjects. One of the things which struck me most during my sojourn in Morvern was the remarkable abundance of insect life, from the lowly midge to the comparatively gigantic dragonfly. Of the five species of dragonflies shown, the largest (*Cordulegaster annulatus*) is to be got in nearly every place, from the glades of the forest and the open moorland to high up on the mountains. It is very difficult to capture, and I found it easiest to catch when dipping down to lay its eggs among the sedgy growths, in running water or stagnant pools. The short thick-set fly (*Libellula quadrimaculata*) I found not to be so common. The other (*Sympetrum scotium*) frequents the roadsides, and has a favourite habit of settling on a flat stone on the middle of the road. He requires to be approached with caution to enable the net to be laid over him and a capture effected. The blue-winged fly (*Calopeteryx virgo*), the prettiest of the lot, I found to be the most abundant of the dragonflies. One spot where I loved to wander and watch them was a small bit of moorland within the confines of the deer-forest, or "sanctuary," as was its rather significant local name, where, if I had been found, I would have forfeited the goodwill of the gamekeeper. Drained by many sluggish ditches and tiny trickling burns, on whose sides grew a profusion of bog-myrtle and heath, this was a very paradise of insect life. Taking the course up one of these rivulets, we catch a glance of a beautiful blue gem as it flashes past in the sunshine and suddenly disappears. A careful search, however, will reveal it settled with closed wings on a sprig of bog-myrtle. Cautiously approaching, it is soon within the folds of the net, when a drop of benzole quietens its struggles and enables it to be boxed with safety. After some expeditions to this spot I became more acquainted with the habits of these insects, and captures, if wished for, were correspondingly easy. One other dragonfly I found somewhat common in the happy hunting-ground was the small red-bodied one (*Pyrrhosoma minium*). This species is rather difficult to capture, owing to its small size, as it appears and disappears in the sunshine like a thread of gossamer. This is the only species I noticed in the actual process of egg-laying. The two insects were generally to be found settled on the stem of the rush. The ovipositor of the female was below the surface of the water, and they never seemed to shift from the one stem. I have often picked up the two insects with my hand when the process of egg-laying was going on.

Of course these insects only appear when the sun is shining, and I have often wondered what becomes of them when a thunder-shower sweeps down from the hills. As long as the clouds are above, you may wander over the whole place and not disturb a single insect, nor can you find one though you search for it. But as soon as the sun breaks forth, the whole place is teeming again with insect life. The dragonflies come forth shining in their armour, and butterflies, from the beautiful fritillaries to the humble meadow brown, disport themselves as if the sun had never been hidden. Where did they shelter their delicate wings during the rain? or are these a different generation from what flitted about an hour ago?—born in a few minutes of sunshine, to disappear as quickly in the first stormy blast.

One other conspicuous insect I met with on these moors was the horse cleg, as it was locally named—the *Tabanus bovinus* of scientists. It appears during the summer, but is met with more frequently during very hot weather. Its distribution in Scotland is not well known, or at least the records of its appearance are scant. Comparing its size with that of an ordinary cleg as found in the Lothians, it will be seen to be a much more formidable insect, and one can well understand the state of terror a horse gets into when the boom of one of them is heard close at hand.

Some distance up Glen Geal, or the White Glen, there is a wonderful and most interesting colony of brown ants. They are well known to the natives as one of the sights of the district. I found their nest under a shady clump of birch trees almost hidden from sight by an undergrowth of brackens. In bulk one of these nests would fill an ordinary farm-cart, being at least 4 feet in height, and wide in proportion. For some distance back from the nest there are numerous well-beaten tracks covered with thousands of these busy little workers, some returning to their houses laden with spoil and others setting out on a foraging expedition.

Turning to the animal life of the district, Morvern is more remarkable for the absence of some of our commoner species than from any rarities to be found in it. There is not a water-vole to be found in the whole district. The bank-vole is not recorded, but I think is there, although I never was able to capture one. I had the pleasure of adding the water-shrew to the fauna of the district, there being no record of its capture in Mr Harvie-Brown's book. The individual specimen I refer to will be found in the collection in the Edinburgh Museum. The squirrel is unknown in Morvern, but its recent appearance in the neighbouring parish of Ardnamurchan is recorded in the last number of the 'Annals of Scottish Natural History.'[1] There is one hedgehog in Morvern, but that is kept as a pet. It was brought from the South country some years ago, and at one time escaped and roamed at liberty for two years. It was captured ultimately some miles from the spot where it had been confined. The true wild cat, after an absence of sixteen years, made its appearance in the winter of 1894-5, when two specimens were killed near the ruins of Ardtornish Castle. This was coincident with the appearance of the wild cat in Ardnamurchan and other places in Scotland, where it was not supposed it would ever be seen again. The long-eared bat and the Pipistrelle both occur in the ruins of old Loch Aline Castle. No record is given in Mr Harvie-Brown's book of the long-eared bat. In warm weather the common lizard is occasionally to be seen sunning itself in some cosy corner, but it is not easily captured. The slow-worm or blind-worm I found to be comparatively common. To the natives it is known as the hazel serpent, and they firmly believe it to be poisonous. I made a point of handling every

[1] See 'Ann. Scot. Nat. Hist.,' Jan. 1896, p. 58.

one I came across, but no amount of argument would convince them of its harmless nature. As a result of this belief every one is killed when seen, and the frequency with which the mangled corpses of this interesting reptile are to be found lying on the road on a warm day testifies to its abundance. There is a wealth of Amphibian life, but frogs and toads are held in the greatest abhorrence by the Highlanders. The palmated newt was the only species of its kind I met with.

The golden eagle is seen as an occasional visitant, and more rarely the white-tailed eagle. Along the cliffs of Loch Aline the kestrel hawk rears its young unmolested by the game-keepers, who wage a ceaseless war against the other members of the tribe. The common buzzard is met with in diminishing numbers, and the war of extermination will be in the end successful. There is a heronry in one of the deep gorges in the margin of Loch Aline, and the bird itself is a familiar figure, standing sentinel along the shores of the loch. The tawny owl and the barn owl are the only species which came under my notice. The raven frequents the more solitary corries, and I have seen four rise croaking from the carcass of a sheep. The grey or hooded crow is abundant, and is accounted very destructive to game.

Among the smaller birds I was surprised to find the bull-finch as common in the woods of Ardtornish as the chaffinch is in the Mid-Lothian covers. This abundance may be due to the large area of suitable feeding-ground that exists, as, in recent years, many hundreds of acres have been planted with young spruce and other fir trees, and with them has increased the wealth of insect and bird life. Another bird which seems to have been attracted to these plantations is the lesser red-poll, which is fairly numerous. The common sparrow is conspicuous only by its absence, a few at the farm-steading being the only colony in that district. Among aquatic birds I noticed the widgeon, with young a few days old, on Loch Aline. This duck is not previously recorded as breeding in the locality.

VII.—*NOTES ON LAST SUMMER'S EXCURSIONS.*

By Dr DAVIES, President.

(*Read March 25, 1896.*)

I. Auchencorth.

The first excursion of the season took place on Saturday, May 4, to Auchencorth moor and moss. The party, numbering twenty-eight members and friends, arrived about two o'clock at Penicuik,—now, perhaps, the chief centre of the paper industry in Scotland, and where the manufacture of that article has been carried on for nearly two hundred years. Without stopping to examine Penicuik or any of its interesting objects, the party proceeded at once to Auchencorth, a distance of between two and three miles, the principal object of the excursion being to see the nesting-place of the black-headed gull, which usually abounds there at this season. Most unfortunately, however, we were not successful in our search, for although the keepers told us that in previous years the birds had resorted there in thousands, few were now seen, and not a single nest or egg was met with. But though the nests and eggs of the black-headed gull were conspicuous by their absence, the excursion was by no means barren. Specimens of the emperor moth were captured, and a number of plants obtained, of which the most important was the rather rare fern, the moonwort (*Botrychium lunaria*), a new station for which was discovered by one of our members on the roadside between Penicuik and Auchencorth, the nearest point at which it had previously been found being probably West Linton. The elegant golden plover, one of the most abundant of our native species, which is found in vast flocks on the coast in winter, retiring in spring to the moors and mountains to breed, was also seen, and their nests and eggs found, during this excursion. The beautiful little willow wren, one of the commonest of our summer warblers, was heard, though not seen. The curlew, which during winter frequents the coast in flocks, was also seen, as were their nests and eggs.

The crow, though from its habits not very frequently seen, is pretty widely distributed, and occurs in the plantations at Auchencorth in some abundance. The mallard or wild duck is another bird which is often met with at Auchencorth, though not seen during our excursion. The teal, which is also found at Auchencorth, is the smallest of the British ducks, being less than half the size of the mallard: it is, nevertheless, from its abundance, valuable as food. The twite, or mountain linnet, is one of our commonest birds, remaining with us throughout the year. Several were seen at Auchencorth. It is a familiar bird, more easily tamed than the common linnet. The dunlin is usually abundant at Auchencorth, though it was not seen during our excursion.

II. Roslin.

The second excursion was from Roslin to Polton, on Saturday, May 18. The party was unfortunately small, only fifteen members and friends being present. Our party proceeded at once to the glen, leaving unvisited the beautiful and probably unique chapel. Entering the glen, the party devoted themselves to examining the flora of the locality. Many plants were found, of which perhaps the most interesting was the toothwort (*Lathræa squamaria*), of which a single specimen was seen, but not gathered.

III.—Joppa.

The first evening excursion took place on Wednesday, May 22, to Joppa rocks, with the object of investigating the geology and the marine flora and fauna of this interesting locality. The greater part of the evening was devoted to a most interesting description of the geology of the district by Mr Day, who, with the aid of maps and an ingenious model, pointed out and described the various strata and minerals which occur in the neighbourhood. The state of the tide was not very favourable for exploring the fauna and flora, these being best investigated at low water of spring-tides, which occur on this coast at somewhat inconvenient hours. Nevertheless, a few interesting objects were noticed. No Protozoa were, so far as I know, collected, but sponges, star-fish, and sea-anemones were found. Two species of anemone were collected—the beadlet (*Actinia mesembryanthemum*), and the dahlia wartlet (*Telia crassicornis*). Of these the former is probably much the more common, though from its more conspicuous appearance, and the more open positions which it occupies on the rocks, it is often seen in quantities; whilst the wartlet, from its more retiring habits, and a way it has of almost covering itself with small particles of stone or shell, may, though just as abundant, be entirely overlooked. Whelks, dog-whelks, limpets, and other molluscs were found in abundance.

IV.—Leith Walk Nurseries.

On May 25 the Society arranged to visit the Leith Walk Nurseries of Messrs Methven & Son. The day being extremely unfavourable, there was a very small attendance. The party was met by our fellow-member, Mr Hugh Fraser, manager at the Nurseries, and most kindly conducted over the garden and conservatories.

V.—Burntisland.

On June 1, in conjunction with the Kirkcaldy Naturalists' Society, a number of our members, under the guidance of Mr Goodchild, visited Burntisland, where a fine series of exposures of volcanic and other eruptive rocks, associated with the Lower Carboniferous strata of the district, were pointed out. Some interesting fossils were obtained in the neighbourhood of Kinghorn, and a number of plants were gathered; but the pleasure of the excursion was marred in a great measure by the inclemency of the weather.

VI. Blackford Hill.

On Wednesday, June 5, an evening excursion was arranged to visit Blackford Hill and the Braids, under the leadership of Mr Crawford. The party was the largest of the season, numbering about 53, and a special attraction was afforded by the Astronomer-Royal, Professor Copeland, who most kindly conducted the party over the new Royal Observatory in course of erection there, giving a very lucid and interesting explanation of the purposes for which the various portions of the buildings were destined, and of the instruments which, though not then in position, were very shortly to be placed there. When complete, the cost of the Observatory will be about £40,000, and, at least so far as regards the building itself, it will then be probably the finest Observatory in Great Britain, though the instruments are smaller and the staff numerically much less than those of Greenwich.

After going over the Observatory the party proceeded to the Braid Hills, where ice-striations and other interesting geological phenomena were pointed out by Mr Crawford.

VII. Gordon Moss.

A whole-day excursion to Gordon Moss was arranged for Saturday, June 15, but only three members attended, and nothing of any rarity was obtained, the date fixed upon being probably rather early for this locality.

VIII. Leith to Portobello.

On the evening of Wednesday, June 19, there was an excursion, under the leadership of Mr Johnston, from Leith to Portobello. The raised sea-beach on Leith Links and other interesting geological features were pointed out, and examples of ice-markings were noticed on many of the rocks, while a number of plants were gathered along the shore.

IX. Buckhaven to Wemyss.

On June 29 the Society paid a visit to Wemyss. The special object of the visit was to explore the series of caves between Buckhaven and Wemyss, many of which show curious and highly interesting sculptures on their walls, and of which there are several on the coast between these two places. The party numbered about twenty. On arriving at Buckhaven the party was met by Dr Aitken of that town, who had very kindly undertaken to act as leader, and proceeded at once to examine the caves. The first of these, going westward from Buckhaven, is known as the Gas-Works Cave, the entrance opening on to the premises of the gas company. This, so far as I know, does not exhibit any sculptures, but is nevertheless interesting in many other respects. It is surrounded by a bench-like projecting piece of rock, out of which at the end next the entrance there is hewn a mortar—not of the usual flower-pot shape, but of a more globular form; and not very many years ago traces of grain were still remaining in it. This may of course merely indicate its use in comparatively recent times, but as the entrance to this cave was for long covered up, it is perhaps not going too far to assume that the contents are ancient, and have been preserved in consequence of having been protected from the action of the air. Its floor has at one time been paved with limestone boulders, no doubt collected from the adjoining beach. The next, and perhaps the most interesting of all the caves, is known as Jonathan's Cave, in consequence, it is said, of a man named Jonathan and his family having used it as a place of residence. It is a fine cave, 70 feet long and 20 feet in breadth, but not of any great height. It runs right under the ancient ruin known as Macduff's Castle. The sculpturings are, I believe, all on the western wall, none having been found on the east side, but on a ledge at the top of the cave there are crosses and other figures. On the west wall we find numerous animal forms and other sculptures, and the so-called "spectacle ornament" is of frequent occurrence. The next in order is the Doo Cave, or Dovecot Cave, it having at one time been fitted up as a pigeon-house. It is one of the finest of the series, measuring about 100 feet in length, and from 60 to 70 in breadth, and being also very lofty. There are many figures sculptured on the wall, both of animal and other forms, and generally resembling those found in Jonathan's Cave. The next cave, though smaller, has three entrances, and has many sculpturings on its sides, apparently very similar to those of the other caves, but much more obliterated by the action of the weather than in any of the others. It has been named the Court Cave, from a tradition that King James IV., being overtaken by night in this locality, spent a merry evening within the cave in company with a tribe of gipsies whom he found occupying it, and who before the hour of parting discovered who their visitor was. More easterly still is the cave known as the Glasshouse Cave. This lies between the villages of East and West Wemyss, but I have never visited it. It is said to be the most magnificent of the series, the height of the roof being 100 feet. The appearance of its walls has suggested the idea that it has been used for the manufacture of glass, whence its name, but I am not aware that there is any justification for this theory. Another cave still farther east was not visited by the Society, but is said to have been at one time the retreat or *desertum* of the missionary St Serf, whence some derive the name of the adjoining town of Dysart. The Wemyss caves are believed to have been resorted to by St Adrian and his companions when engaged in their missionary labours amongst the Picts of Fife, and it may be that the curious sculpturings, closely resembling as they do the sculptures on the sculptured stones of Scotland, have been graven by their hands.

After a very interesting discourse from Mr Goodchild on the geology of the caves and district, some of the party proceeded along the coast to visit the Shakespearian garden near one of the two old Popish chapels which once existed in the locality, the other one being farther east at Methil.

X.—Arthur's Seat.

There was an evening excursion to Arthur's Seat on Wednesday, July 3, under the guidance of Mr Johnston and Mr Steele, but owing to the wet weather the attendance was very small,—only seven members, of whom I was not one, venturing round.

XI.—Dredging Excursion.

On Saturday, July 6, one of the most interesting excursions of the season took place, when some thirty members of the Society were enabled, under very favourable conditions of weather, to make acquaintance with the practical operations of dredging and trawling—the Fishery Board's steam-yacht, the Garland, having, through the kind offices of Dr Wemyss

Fulton, been placed at the disposal of the Society for that purpose. Under the superintendence of our fellow-member, Mr Thomas Scott, F.L.S., of the Fishery Board, the operations of dredging and trawling were successfully carried on. Many interesting specimens, especially of the Invertebrata, representing the Protozoa, sponges, echinodermata, worms, crustaceans, and mollusca, as well as several vertebrates, were secured. The party returned to Granton in the evening, having spent a most enjoyable and instructive afternoon.

XII.—Falkland.

Falkland was the destination of our party on the occasion of the twelfth excursion, which took place on the 13th July—a number of the members of the Kirkcaldy Naturalists' Society joining us at Falkland. At the Palace, in and around which some of the most interesting events of past history centre, our party was met by Major Wood, the resident Factor of the Marquis of Bute, who most kindly conducted us over the building. After examining the Palace and town, the party divided, some going to Maspie Den, while others proceeded to Falkland House under the guidance of Major Wood. Nothing of special interest from a Natural History point of view was, so far as I am aware, met with.

XIII.—Davidson's Mains.

On July 17 the Society had an excursion to Davidson's Mains, under the guidance of Dr Sprague, then President. The party numbered eighteen. The principal object of investigation was the marl-pit, where the President pointed out a number of interesting objects, amongst the rarer being a variety of the comfrey (*Symphytum officinale* var. *patens*), and the water-soldier (*Stratiotes aloides*), a plant not indigenous in Scotland, and introduced into the Davidson's Mains marl-pit, I believe, by the late Dr Graham, Professor of Botany in the University of Edinburgh, some fifty or sixty years ago. Many other plants, both Phanerogams and Cryptogams, were found. In a ditch running from the marl-pit, one of our members obtained specimens of five or six different species of diatoms.

After an exhaustive examination of the marl-pit, the party was kindly entertained at Marchfield by Dr and Mrs Sprague.

The final excursion of the summer was arranged to visit the Pentland Hills on July 27, but owing to rain it did not take place.

[The above paper, which is here given in an abridged form, was illustrated by a large number of lantern slides, the greater part of these being from photographs taken at the excursions by the President, Dr Davies.]

VIII.—*RECENT RESEARCHES ON SNAKE POISON,*

Especially those of Dr Cunningham of Calcutta.

By Dr WILLIAM WATSON.

(Read April 22, 1896.)

Snakes belong to the great group of reptiles or creeping animals whose females do not suckle their young. They have only one condyle, not two, on the occipital bone, and their lower jaw is articulated, not directly to the skull, as in mammals, but through an intervening quadrate bone. It follows, therefore, that mammals cannot be descended from reptiles, for no true Darwinian believes in Anabolism and Catabolism, as the followers of Henslow vainly talk.

Snakes are not very far removed from lizards, and if asked to distinguish between a lizard and a snake, it would not be a bad answer to say that a lizard had legs and a snake none. But further inquiry would modify this answer. On dissection, it is found that true snakes are highly specialised, and have five other peculiarities besides wanting legs: (1) They have only one lung, the left lung being rudimentary; (2) they have no bladder; (3) they have no true eyelids, but have transparent lids over the eyes; (4) their jaws are united only by membrane; (5) they have no tympanum. Only animals having these peculiarities are considered true snakes, and legless animals, which are otherwise normal, are relegated to lizards.

Adopting this classification, the blind-worm or slow-worm of Britain is a lizard, not a snake. It is quite harmless, in spite of the rhyme—

> "'If I could hear, and you could see,
> None would live but you and me,'
> Said the adder to the blind-worm."

Dumeril and Bibron have divided snakes, from their teeth, into five families: (1) *Opoterodonts*—teeth in one jaw only; (2) *Aglyphodonts*—no grooved teeth anywhere; (3) *Opisthoglyphs*—grooved teeth behind; (4) *Proteroglyphs*—grooved teeth in front; (5) *Solenoglyphs*—teeth hollow. The last two contain the poisonous snakes, and it is with them only we have to do. Our British adder belongs to the fifth family, as do also the two common vipers of India and the rattlesnake of America. The cobra of India, the most common snake in the world, belongs to the fourth family. The two families differ in many ways. Thus—(1) The vipers are viviparous, the cobras oviparous; (2) the vipers have scaly heads, the cobras shielded heads; (3) the vipers have a very small upper jaw on a long pedicel, while the cobras have jaws like those of harmless snakes, though the teeth are unlike.

Notwithstanding these great differences, it was assumed till quite lately that there was only one kind of snake venom. Even Dr Fayrer, in his great book on Indian snakes, makes no distinction of kind in the venom of the two families; and a recent French writer, M. Calmette, maintains that they are identical in kind, and differ only in degree. This is like a fungologist maintaining that the poison of the *Amanita* section of Agarics is identical with the poison of the *Hypholoma* section, ignoring the researches of Plowright. The first who distinguished cobra venom from viper venom was Dr Wall of Madras: then Dr Norris Wolfenden showed that the two kinds of venom, when analysed, differed in composition, and that the nerves of the man bitten by a cobra remained sensitive to the electric current, which was not the case after viper bite. In America, Dr Weir Mitchell of Philadelphia made a most interesting discovery. He dissolved venom in water, and put it in contact with an animal membrane. He found that cobra venom passed through the membrane, while viper venom did not. The first he named venom peptone; the second, venom globuline.

This discovery has important practical bearings. You all know the story of Queen Eleanor sucking the poison-wound of her husband, King Edward. In like manner, snake wounds have often been sucked. It follows from Dr Weir Mitchell's discovery that this would be safe in viper poisoning, provided there was no cut in the lips of the person who sucked, but would always be unsafe in cobra poisoning.

There is a well-known story of a botanist who wrote a book on the structure of the leaf of the laurel. It rather puzzled his readers, till they discovered that the plant he had been examining was not the sweet-scented but the cherry laurel. Equally off the point are all observations on cobra poison, if applied to viper poison; or on viper poison, if applied to cobra poison.

Recently, my friend Dr Cunningham, of Calcutta, has studied the symptoms resulting from cobra bite and viper bite. He finds that the poison of the cobra is a blood poison, or ferment, and that it kills by inducing changes in the blood which unfits it for the respiratory demands of the system. It kills as carbonic oxide does in coal-gas poisoning. There is increased lachrymal, nasal, and salivary secretion, with occasional nausea and vomiting. This is followed by paralysis, especially of the hind limbs, and by asphyxia, coma, and anæsthesia. Reduced hæmoglobin replaces oxyhæmoglobin, and when this has occurred to the extent of thirty per cent, death from asphyxia ensues. It is not a nerve poison, as almost all previous writers have supposed. This is proved by the existence of a latent period, however large the dose may be. In true nerve poisons, such as strychnia, a large dose kills instantaneously. Thus cobra poison is a simple blood poison.

With regard to viper poison, Dr Cunningham shows that what occurs, or may occur, is much more complicated. Viper venom contains two very different poisonous principles—(1) a nerve poison, with local muscular action; (2) a septic poison, causing effusions of blood both at the site of the bite and throughout the body, resembling somewhat the effects of subcutaneous injection of comma bacillus. With cobra poison there is a latent period, then death, if at all, within twenty-four hours. With viper poisoning there is either instant death, or death after three or four days, preceded by the appearance of sanguinolent effusions. For a day or two the person bitten may show no symptoms whatever.

Another observation of Dr Cunningham's is that cobra venom, freely diluted in water, remains poisonous. Viper venom, if much diluted, becomes quite innocuous.

As is well known, after death from cobra bite the blood is usually dark and coagulable. After death from viper bite it is brick-red and incoagulable.

As already said, the cobra is the most common and most widely spread snake in the world, found all over the tropics of Asia and Africa. It owes its success in life to its poison fangs and its conspicuous hood. The poison fang alone would have done it little good, for snakes are preyed on by eagles, peacocks, and ichneumons; and it would not benefit this particular snake that it had a poison tooth, unless it had some means of impressing this fact on its enemies. This is done by the conspicuous hood and the spectacle marks. In the course of ages eagles, peacocks, and ichneumons have learned not to touch cobras, but to make their dinners off less formidable snakes.

Vipers have a poison more deadly than that of the cobra, but they have no means of proving this at a glance to their enemies. Eagles kill them, taking them for harmless snakes. Hence cobras are numerous, while vipers are comparatively few. The one is a success, the other a failure.

The cobra is a beautiful creature, with its dilatable neck, and spots like a pair of spectacles. It rarely attacks a human being unprovoked. It is easily tamed, and learns to love those who feed it. In lonely houses in India, pet cobras are kept as a protection against robbers.

When a cobra is attacked by a man, it tries to run away to its hole; but if at bay, and with no hole to flee to, it fights bravely for its life. Rearing itself half erect, with expanded hood, it strikes boldly at its foe. The cobra is at once gentle and brave. It uses its venom as a good man uses his strength—for defence, not for offence. Hence it is associated in Buddhist sculptures with the great teacher himself—

> "Prince Sidharta named on earth,
> All honoured, wisest, best, most pitiful,
> The teacher of Nirvana and the law."

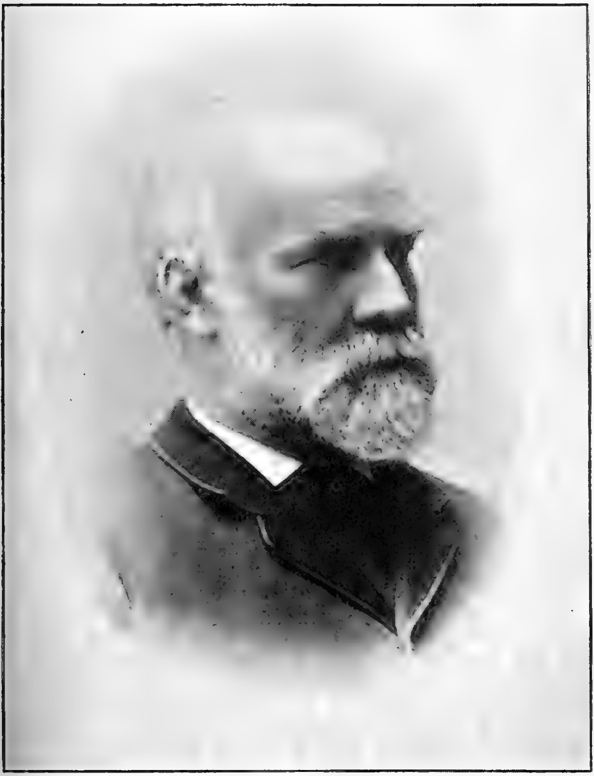
At this meeting Mr Hugh Fraser gave a short address on Yews, and exhibited some interesting forms of the yew. Mrs Carphin also read a paper on the Vampire-bat, with specimen.

In Memoriam: *Dr ROBERT BROWN.*

By Dr DAVIES, President.

Dr Robert Brown was the first President of the Society, and at the time of his death an honorary member. I therefore think it but right that I should here place on record some brief memorial of his useful and laborious life.

The son of Thomas Brown, Esq. of Campster, Caithness, Robert Brown was born on March 23, 1842. But the family soon after removed to Coldstream, Berwickshire, and here he received his early education. At the age of sixteen he entered the University of Edinburgh, where, though he did not graduate, he had a distinguished career. Afterwards he studied on the Continent, and in 1868 received the degree of Doctor of Philosophy from the University of Rostock. In 1861 he visited Jan Mayen, Spitzbergen, and the shores of Baffin's Bay, and was the first to point out the now universally admitted cause of the discoloration of the waters of the Arctic Ocean. Afterwards he spent three years in British North America, and he commanded two different exploring expeditions to Vancouver Island. In 1867 he again visited the Arctic regions; and, together with Mr Edward Whymper, he made the first attempt by Englishmen to penetrate the icy regions of the interior of Greenland, and explored the glacial formation and the botany of that country. From 1863 to 1866 he travelled for scientific purposes over a great part of the world, and made many valuable discoveries. After finally returning to Scotland about 1873, he lectured on Botany, Zoology, and Geology at the High School and the Heriot-Watt College, Edinburgh, the Mechanics' Institution, Glasgow, and elsewhere. About this time Dr Brown spent most of his vacations in Denmark; and in the autumn of 1875 he married Augusta Rudmose, daughter of Neal Rudmose of Fersley, near Copenhagen, and shortly after settled in London. Being offered a post on the 'Echo,' he finally adopted journalism as his profession, and in 1878 joined the editorial staff of the 'Standard,' bringing to his work an experience which rarely falls to the lot of any journalist. He was fond of the African shore of the Mediterranean, and spent many of his holidays in Tunis, Morocco, and Algiers; and he possessed an



DR ROBERT BROWN,

FIRST PRESIDENT,

EDIN. FIELD NAT. AND MICRO. SOC.

intimate knowledge of the history and literature of these countries. In conjunction with Sir Lambert Playfair he compiled for the Royal Geographical Society a Bibliography of Morocco; whilst the Transactions of the learned societies contain many papers by him on the glaciers, the fauna, and the flora of the Northern and Arctic regions. Of about thirty volumes which he wrote or edited, the best known are perhaps his 'Manual of Botany,' 'Races of Mankind,' 'Countries of the World,' 'Our Earth and its Story,' and 'The Story of Africa,' all of which, except the first, were published by Messrs Cassell & Co. At the time of his death he was translating and editing for the Hakluyt Society an edition of Leo Africanus. In addition to these, he wrote an endless number —it is said nearly 3000—scientific articles and reviews. He was President of the Royal Physical Society and a Vice-President of the Botanical Society, and, as I have already said, was the first President of this Society. Dr Brown died at his residence at Streatham, London, on October 26, 1895, at the early age of fifty-three, leaving a widow and three children—two sons and a daughter—to mourn his loss. He was interred at Norwood Cemetery on October 30.

EXHIBITS IN NATURAL HISTORY.

THE following were the chief objects of interest in Natural History and Microscopy exhibited during the Session:—

By MR W. FORGAN, F.R.M.S.

The Zeiss vertical illuminator; a Zeiss homogeneous oil-immersion $\frac{1}{12}$ object-glass; a new apochromatic object-glass, 36 mm., by Zeiss.

By MRS SPRAGUE.

Flexible stone from Agra; Pinna shell with byssus; Nest of North-American humming-bird; a collection of plants from Iceland.

By MR BRUCE CAMPBELL.

Two nests of the Long-tailed Tit, from Dalmeny.

By MRS CARPHIN.

Lizards, Chameleon, Snake, and Beetles from Alexandria; three species of *Tetrodon* and two of *Diodon*.

By THE SECRETARY.

Physcia ciliare, a lichen from Old Calabar.

ANNUAL BUSINESS MEETING.

THE Annual Meeting was held at 20 George Street on the evening of October 28,—Dr Davies, President, in the chair.

Before commencing the business, the President announced the death, on the previous evening, of Mr Andrew Moffat, late Secretary of the Society; and the Hon. Secretary was instructed to send a letter of sympathy to his widow and family.

The following Report was then read by the Secretary:—

During the past session there have been in all 22 meetings of the Society, 6 of which were indoor and 16 were field meetings. The attendance at the former was undoubtedly better than that of the previous session. The papers read at the evening meetings were, with one exception, by members, and many were of local interest. The aggregate attendance at the field meetings was 332, giving an average of more than 20 at each meeting. Greater interest has been taken this season in the work of these excursions, and a start, if nothing more, has been made with the working up of the flora of the county in a more systematic way than has hitherto been done. It is hoped that members will come forward in greater numbers to assist the Committees appointed for this purpose.

Since the list of members was printed last year, 24 names have been withdrawn from the roll and 21 new names added, giving at the close of the Session 1895-96 a total of ordinary members of 145.

The Treasurer's statement of income and expenditure for the year showed a balance carried forward of £32, 7s. 1d., being a larger sum than in any year since the formation of the Society. The Hon. Treasurer, Mr Wm. Coats, was awarded a vote of thanks for his services during the past two years.

The Office-bearers for next Session were then appointed, as follows: The President, Secretary, and Editor were re-elected; Messrs Kilgour, Wright, and Day were elected Vice-Presidents; Mr J. J. Macdonald was elected Treasurer, in room of Mr Coats, resigned; and the vacancies in the Council were filled up by the election of Mrs Ralph Richardson, Miss M. M'Kean, and Messrs Cleland, Coats, Hewat, Pittendrigh, and Rupert Smith.

The Microscopical Section of the Society having arranged to resume practical work, Mr W. C. Crawford, as Convener of the section, made a statement as to what was proposed to be done during the winter,—intimating at the same time that the use of his private laboratory was freely offered to the members for these meetings.

LIST OF PAST PRESIDENTS.

Dr Robt. Brown (*deceased*),	1869.	Mr John Walcot,	1879–1882.
Mr R. Scot Skirving,	1869–1874.	Mr A. B. Herbert,	1882–1885.
Mr Wm. Gorrie (*deceased*),	1874–1877.	Mr Symington Grieve,	1885–1888.
Rev. R. F. Colvin (*deceased*),	1877–1879.	Dr William Watson,	1888–1891.
		Dr Sprague,	1891–1895.

OFFICE-BEARERS, 1895-96.

President.

A. E. Davies, Ph.D.

Vice-Presidents.

W. C. Crawford, M.A., F.R.S.E. | T. W. Kilgour. | T. Wright.

Council.

Dr Watson.
T. C. Day, F.C.S.
J. Heggie.
Mrs Bryden.
Mrs Carphin.
W. Ranken.
J. L. Masterton.
D. Gloag.
T. A. D. Wood.
Mrs Sprague.
J. D. Murray.

Editor of 'Transactions.'

John Lindsay.

Secretary.

A. B. Steele.

Treasurer.

William Coats.

Auditors.

R. C. Millar, C.A.; J. T. Mack.

LIST OF MEMBERS, 1895-96.

Honorary Members.

Henderson, Prof. John R., M.B., C.M., The College, Madras.
Herbert, A. B., Sunnyside, Mitcham, London.
Macfarlane, Prof. J. M., Pennsylvania, U.S.A.
Moffat, A., 13 Wilfrid Terrace, Edinburgh.
Walcot, John, Craiglockhart Hydropathic, Slateford.

Corresponding Members.

Archibald, Stewart, Carroch, Kirriemuir.
Cruickshank, T. M., South Ronaldshay.
Hobkirk, Charles P., Huddersfield.
Hossack, B. H., Craigie Field, Kirkwall.

Ordinary Members.

(*As at October 15, 1896.*)

Adam, James, Comely Park, Dunfermline.
Banks, William, 2 Kilmaurs Road.
Bird, George, 31 Inverleith Row.
Blair, Hugh, 15 Randolph Crescent.
Bonnar, William, 8 Spence Street.
Brewis, Dr, 23 Rutland Street.
Brotherston, George, 27 Lee Crescent, Portobello.
Broun, Miss, 10 Inverleith Row.
Brown, J. C., 2 Eden Terrace.
10 Bryce, George F., 2 Albyn Place.
Bryden, Miss, 72 Great King Street.
Bryden, Mrs, 72 Great King Street.
Buncle, James, 7 Hope Street.
Cairns, Miss Mina, 27 Dick Place.
Calder, A., 2 James St., Portobello.
Campbell, Alex., 62 Marchmont Road.
Campbell, Bruce, British Linen Company Bank, St Andrew Square.
Campbell, Charles, North British and Mercantile Insurance Company, 64 Princes Street.
Carphin, Miss, 52 India Street.
20 Carphin, Mrs, 52 India Street.
Clapperton, Miss Mary E., Gillsland, Spylaw Road.
Clapperton, Mrs W., Stamford Hall, Gullane.
Clarke, William Eagle, 35 Braid Road.
Cleland, George, Bank of Scotland, Leith Walk.
Coats, William, 21 Nelson Street.
Cowan, Charles Wm., Valleyfield, Penicuik.
Craig, Archibald C., 38 Fountainhall Road.
Crawford, Miss Jane C., 1 Lockharton Gardens, Slateford.
Crawford, W. C., 1 Lockharton Gardens, Slateford.
30 Davies, Dr, Tweedbank, West Savile Road—*President*.
Davies, Mrs, Tweedbank, West Savile Road.
Day, T. C., 36 Hillside Crescent.
Denson, E., 83 Comiston Road.
Deuchar, Mrs, Harlaw, Hope Ter.
Dickie, James, 40 Princes Street.
Dowell, Miss, 13 Palmerston Place.
Dowell, Mrs, 13 Palmerston Place.
Duncan, James Patrick, 3 Cobden Road.
Dunn, Malcolm, Palace Gardens, Dalkeith.
40 Durham, Frederick W., Seaforth House, Portobello.
Ewart, James, 1 Dundas Street.
Farquharson, John K., 100 Thirlestane Road.
Ferguson, John, 15 Brighton Place, Portobello.
Fletcher, W., 23 India Street.
Forgan, William, 3 Warriston Crescent.
Fraser, Hugh, Leith Walk Nurseries.
Gartshore, Miss Murray, Ravelston House.
Gloag, David, 9 Barnton Terrace.
Goodchild, J. G., 2 Dalhousie Ter.
50 Graham, Major G., 16 Carlton Street, Stockbridge.
Grieve, Sommerville, 21 Queen's Crescent.
Grieve, Symington, 11 Lauder Road.
Grieve, Mrs Symington, 11 Lauder Road.
Grimshaw, P. H., 26 Montpelier Park.
Harvie-Brown, J. A., Dunipace, Larbert.
Heggie, John, 1 Greenbank Terrace.
Hetherton, Miss M., 13 Sciennes Road.
Hewat, Archibald, 13 Eton Terrace.
Hunter, Robt., 8 Abercromby Place.
60 Johnson, W. H., Tweed Villa, Relugas Road.
Johnston, J. A., 7 Annandale St.
Keith, Sydney, 69 So. Clerk Street.
Kerr, Thomas, 15 Gilmour Road.
Kilgour, Thos. W., 4 East Brighton Crescent, Portobello.
King, Mark, 120 Pitt Street, Bonnington.

Laidlaw, Thomas J., 9 South St Andrew Street.
Laing, Rev. G., 17 Buckingham Terrace.
Law, Mrs, 41 Heriot Row.
Lewis, David, 32 Findhorn Place.
70 Lindsay, John, 43 James St., Pilrig —*Editor of 'Transactions.'*
Lindsay, William, 7 Waterloo Place.
Macadam, Prof. W. Ivison, Slioch, Lady Road, Craigmillar Park.
Macdonald, Dr Alex., 11 Ardmillan Terrace.
M'Donald, J., 24 Marchmont Road.
Macdonald, J. J., Commercial Bank, 32 Warrender Park Road.
M'Gillivray, Wm., 3 Belford Park.
M'Intosh, James, 42 Queen Street.
Mack, J. T., 101 George Street.
Mackay, Mrs F. A., 3 Buckingham Terrace.
80 M'Kean, Miss Minnie, 7 Montagu Terrace, Golden Acre.
Mackenzie, J. Greig, H.M. Register House.
MacLauchlan, J. J., 8 Merchiston Bank Terrace.
MacLean, G. C., 4 Dean Park Crescent.
Masterton, J. L., Dannebrog, 45 Cluny Gardens.
Maxwell, John, 125 George Street.
Millar, R. C., 8 Broughton Place.
Millar, T. J., 8 Broughton Place.
Miller, Alex., 1 Albert Terrace, Musselburgh.
Morrison, Peter, 24 Great King St.
90 Mossman, Robert C., 10 Blacket Pl.
Muir, John, 60 Haymarket Terrace.
Murray, Alister, Blind Asylum, Craigmillar Park.
Murray, Joseph D., 36 Polwarth Gardens.
Nesbit, John, 162 High Street, Portobello.
Oliphant, J. C., 23 Charlotte Square.
Oliver, John S., 12 Greenhill Park.
Paulin, David, 6 Forres Street.
Penman, William, C.E., F.R.M.S., Craigview, Marchhall Road.
Pennefather, Lieut.-Col., 28 Hartington Place, Viewforth.
100 Pillans, Hugh H., 12 Dryden Place.
Pittendrigh, T. M., 29 Comely Bank Road.
Pyatt, W. M.A., Fettes College.
Raeburn, Miss Florence, 49 Manor Place.
Raeburn, Harold, 32 Castle Terrace.
Ranken, William, 11 Spence Street.
Reid, Andrew, 1 Laverockbank Terrace, Trinity Road.
Richardson, A. D., Royal Botanic Garden.
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Robertson, Dr W. Aitchison, 26 Minto Street.
110 Saxby, Mrs, 15 St Leonard's Bank.
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Scott, Thomas, F.L.S., F.Z.S., 14 Lorne Street, Leith.
Semple, Dr Andrew, Caledonian United Service Club, 14 Queen Street.
Smith, David, 12 Belgrave Place.
Smith, Harry W., Norwood, 8 Kilgraston Road.
Smith, Dr James, 4 Brunton Place.
Smith, Rupert, 20 Leopold Place.
Smith, W. A., Falcon Lodge, Murrayfield.
Smith, W. C., 57 Northumberland Street.
120 Sonntag, C. O., 4 Cluny Avenue.
Speedy, Tom, The Inch, Liberton.
Sprague, Dr T. B., 29 Buckingham Terrace.
Sprague, Mrs T. B., 29 Buckingham Terrace.
Sprague, Miss, 29 Buckingham Terrace.
Steele, A. B., 5 Brighton Terrace, Joppa—*Secretary*.
Stevens, Dr John, 3 Shandon Crescent.
Stevenson, Miss, 2 Albert Place.
Stewart, Robert, S.S.C., 7 East Claremont Street.
Storrie, James, North British and Mercantile Insurance Company, 64 Princes Street.
130 Struthers, Professor, 24 Buckingham Terrace.
Terras, James, B.Sc., 40 Findhorn Place.
Thomson, Lockhart, Derreen, Murrayfield.
Townsend, Miss E. A., 20 St Catherine's Place, Grange.
Traquair, Dr, 8 Dean Park Crescent.

Watson, Robert, M.A., 25 Warrender Park Road.
Watson, Dr Wm., Waverley House, Slateford.
Watson, Mrs, Waverley House, Slateford.
Weir, Miss E. A., 18 West Claremont Street.
Welsh, Mrs, Redbraes, Broughton Road.
140 White, Miss, 21 Bernard Terrace.
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Wood, T. A. D., Viewforth, Brunstane Road, Joppa.
Wright, J. P., 6 Grosvenor Cres.
Wright, Thomas, 13 Brunton Terrace.
145 Young, David E., 131 Mayfield Road.

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TRANSACTIONS

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SESSION 1896-97

CONTENTS.

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I.—*MIGRATION OF THE HIRUNDINES.*

By Mr A. B. HERBERT.

(*Read Nov. 25, 1896.*)

On the 22nd of September last, at 7.30 A.M., I noticed that the air seemed very full of the swallow tribe, and on looking up to a great altitude, I observed incalculable numbers coming quickly into the range of vision. The atmosphere was very clear, and they looked mere specks coming down, I imagined, from a height where they were invisible. It at once occurred to me that this was strongly corroborative of the veteran Herr Gätke's statement, from his observations at Heligoland, that many birds in migrating fly at such an extreme height that they are almost, or perhaps quite, invisible. Their descent to within a short distance from the ground was very perpendicular and rapid, and they all moved off in one direction towards the river Wandle. I presume it was a vast nocturnal migration, and that they descended to the river either to drink or to obtain a breakfast of gnats or other insects found near the stream. Many in their descent came so near to me that there was no difficulty in identifying the species, and all I noticed were house martins (*Hirundo urbica*). I would not for a moment attempt to give an estimate of numbers: when Herr Gätke mentions tens of thousands we may perhaps think it an exaggeration, but after what I witnessed I will merely remark that there was *quite a cloud* of birds. How much I wish many members of our Club could have been near me to have observed what was to me a most interesting sight, and one never to be forgotten!

One circumstance must be gratifying to us all—namely, the knowledge that these most useful birds exist in such quite incalculable numbers. I observe in the newspapers that immense flights of the swallow tribe were seen about the same time at Chiswick and Norwood.

SUNNYSIDE, MORDEN, SURREY,
9th Nov. 1896.

II.—BEES: A YEAR'S WORK IN THE HIVE.

BY MR ALISTER MURRAY.

(*Read Nov. 25, 1896.*)

FROM a very early period bees have excited the attention of naturalists, as well as of many intelligent persons who made no claim to scientific research; and there need be no wonder at this, seeing they are a most delightful study. I am only sorry that the paper upon such an interesting subject should be given by myself, for I am afraid that I will scarcely be able to do it justice.

What I shall say here about bees will comprise a few notes from my own observations during at least thirty years' work with them. I shall leave it to the scientific entomologist to explain to you the structure of the bee. I believe that the entomologist's and naturalist's ideas and information about bees are limited mostly to what is seen at the dissecting-table or under the microscope. Sometimes the purely scientific observer may get a few hours', it may be days', or even weeks', observation of them in their natural state; but what can a few weeks or months do to give one a fair idea of the natural habits of bees? Therefore, from my long study of them in their natural state, I may be able to tell you some things about them which are often very imperfectly known.

Before the introduction of the frame-hive the bee-hive was almost a sealed book to us, but we now know a great many things that were formerly only guessed at, and very far from correct these guesses often were. Now we can take out the combs, with bees upon them, like books from a bookcase, and examine the bees and their work as often as we please.

I may here state that bee-keeping is quite a hobby of mine; and as hardly any one likes to be odd, it would be a great pleasure for me to know of any of the members of this Society taking to bee-keeping. Bees can be kept almost anywhere; but when in a suitable district of country, a more pleasant, interesting, instructive, and profitable occupation can scarcely be found. The interest attached to bee-keeping becomes very much stronger as one gets acquainted with the natural instincts and economy of the bees—in fact, so very strong does it sometimes become, that it may truly be said the bee-keeper "has a bee in his bonnet."

Having selected the natural habits of the bee for my paper to-night, I shall explain the work done by a swarm of bees during one year. Of course I shall confine my remarks mostly to the hive- or honey-bee, usually kept by us for supplying honey and wax. As far as I know, it is the only bee that we can get a supply of honey from, and the only one that produces pure wax. It may be interesting to our members to be told something about the other two insects of this country which build combs and have a life-history similar to our friend the honey-bee—viz., the humble-bee, or, as it is often called, the "bumbee," of which there are several species; and that rather pretty but impudent little thief in his uniform of black-and-gold, the common wasp. All three build combs, and the communities of each are composed of queen, workers, and drones. The combs of the honey-bee are made of pure wax, and are large perpendicular slabs of six-sided cells, lying horizontal, or nearly so. There are generally two kinds of cells—(1) worker cells by themselves, five side by side being an inch, and with nearly twenty-nine cells to the square inch; and (2) drone cells by themselves, four of which measure an inch or a little over, and eighteen, or very nearly eighteen and a half, to the square inch. The queen-cells are very different from the others: they are a mixture of wax and pollen, and are wider at the bottom than the top—I mean, the inner end of the cell, as the mouth is at the bottom. Queen cells always hang down, and are built in the hive without any regard to order or position. Now the combs of the humble-bees are made of a mixture of pollen and honey, without, I think, any wax. The cells are like little cups, circular in form, with their mouths up, and built in a confused heap,—worker-cells, drone-cells, and queen-cells being all mixed up. The combs of the wasp, on the other hand, are built in tiers, with cells on the under side, with the mouths down, and are composed of what is known to us as paper. The cells are six-sided, like those of the honey-bee, but are a little smaller, and generally by themselves—queen and drone cells together in separate combs. I think it very interesting, from a naturalist's point of view, that these three insects should resemble each other so much, and yet in some points be so different.

I shall now tell you how the bees are reared or propagated. The queen deposits an egg in a worker-cell for a worker, which is hatched in three days, fed for five days, then sealed over by the bees with a mixture of pollen and wax. The larva now takes two days to spin its cocoon, then rests for three days, changes into the nymph on the fourteenth day, and continues in that state for seven days, thus taking twenty-one days to become a perfect insect, when it leaves the cell. The queen next deposits a drone-egg in a drone-cell, which also hatches in three days, but is fed for six days. This larva requires three days to spin its cocoon, and then rests for four days, but takes, like the worker, one day to be transformed into the nymph, and in seven days leaves the cell a perfect insect, having taken twenty-four days for the process.

If it is a queen that is to be reared, the workers act in a very different manner. This time the queen does not deposit an egg in the queen-cell; but the workers take an egg and put it in what is very often, as yet, a very shallow cup, in a mass of wax and pollen, and surround it with a large quantity of "royal jelly," a substance very like corn-flour to look at. They then build out the cell till it is at least twice as long as a worker-cell, circular instead of six-sided, and, as before stated, at right angles to the other cells. The larva feeds for five days, but only takes one day to spin its cocoon, then rests two days, and is transformed in one day, only remaining three days in the nymph state, when it emerges a handsome and perfect queen, having only taken fifteen days to become what will very likely be the mother of nearly, if not quite, one million children. The queen will leave the hive in from three to five days to be mated, and never again quits it except in swarming. The worker leaves the hive to fly from the ninth to the fourteenth day, and the drone about the same time. A queen will live for five years, but the extreme age of a worker is nine months, though during summer it does not live for more than six weeks or two months. I have noticed an entire change in the population of a hive in six weeks. As a rule, drones live about two months, except in a queenless hive, when they may live for four or five months.

Now as to the furnishing of a hive, this is generally done about the month of June—I mean, in natural cases. When a swarm has come off, if left to themselves it is very hard to say where the bees may want to take up house, for it may be in a hole in an old tree, or on the roof of a house, or in an unused chimney, or in a church steeple or belfry of any kind, in all of which places I have seen bees. But for convenience we shall suppose our swarm in an old straw-skep or hive. The first thing the bees do is to set up a chemical factory. Each bee, on leaving the hive, is laden with honey, so, clustering in the top of the hive, they raise the temperature to such a degree that the honey by some chemical process is converted into wax, which exudes in thin scales from between the first and second and second and third rings of the under side of the abdomen. These scales are picked up by the bees and carried by them to the top of the hive, where they are kneaded into a solid mass and stuck on the top of the hive in a thin ridge. After this ridge is formed a number of bees set to work to construct the cells. In a common skep they generally begin three or four combs, and there seems to be a general understanding that they are all to run in one particular direction—that is, parallel with each other. The bees who are making the cells scrape the wax out of the bottom and build it upon the edge of the cell, which is always much thicker at the edge than the walls farther down. They are also very good at measuring distances, for they usually put the combs $1\frac{1}{2}$ inch from centre to centre, except for storing honey, when they make them any thickness, from 1 inch to 2 or even 3 inches.

Now if all goes well, and the weather is fine, our swarm will have filled the hive with comb in from three to five weeks, and will have added from 12,000 to 14,000 bees to their numbers, and used from 50 to 60 lb. of honey during the time.

I only know of four varieties of bees that are kept for collecting honey—viz., (1) the Ligurian or Italian bee, which differs from the common bee in having three bright orange-coloured bands across the abdomen; (2) the Carniolian or Austrian bee, which is covered with short white hairs, giving it a mealy appearance; (3) the common British or brown bee. Pure bees of either of the above varieties are very quiet, and are easily handled, but crosses of any two are the best breeders and workers, though very much given to stinging. Then there is (4) the Cyprian bee, somewhat of the same colour as the Ligurian, perhaps a little brighter, but seldom kept in this country, as they are such wicked stinging bees that one is scarcely safe to go within sight of the hive.

Now, shortly, I shall tell you something about the year's work, as carried on month by month in the hive.

January.—If the swarm is strong and the weather not too cold, the bees will show some life now, and very likely the queen may deposit some eggs in the centre of the hive. The hive must now be kept warm.

February.—If the weather is at all mild with some sunshine, the bees will now take a flight during the middle of the day, and breeding will be going on.

March.—In fine weather the bees will be very busy now; young bees will be getting on the wing, and gathering pollen from the early flowers.

April.—If all has gone on well, the swarm will now be getting strong—*i.e.*, have increased in numbers; and if there is any water about, they may be noticed carrying in quantities of it, which they use along with honey and pollen for feeding the larvæ or young bees. Towards the end of the month a few drones may be seen on bright days.

May.—This is one of the busiest months for the bees. Drones will now be more numerous, showing that one of the prettiest and most remarkable sights connected with bees will very soon take place—viz., swarming. This is one of the most wonderful arrangements of nature for the increase of the species. Where all the older bees leave the hive, accompanied by the old queen, to seek a new home, all they take with them is as much honey as each can carry; and it is a sight well worth going some distance to witness, when the bees come out of the hive. From 30,000 to 40,000 bees are all quitting the hive, leaving it empty in about three or four minutes, and all flying in a cloud about one's head. The sight is enough to make one who never saw it before wonder what has gone wrong with the bees, and very likely to wish he were farther from them. But bees rarely sting during swarming. After flying about for a short time, they will begin to collect about a particular point, such as a tree or a bush, or any kind of plant which rises a few feet above the ground. If the queen is among them, they will generally hang in a large cluster until the bee-keeper puts them in a skep or hive, which is usually done by shaking them off the branch into the hive, and then turning up the hive and putting it on a board near where they were hanging, when all the bees still flying about will very soon enter the hive. Swarming has brought us into June.

June.—This month in Scotland is often a swarming month, but when the first swarm came off at the end of last month, the second will probably come now (seconds do not always come, although sometimes a third will also come). About a week after the first come off, by listening at the hive in the evening the queens will be heard "piping," or emitting curious sounds, which always seem to me to be a challenge to fight. This they would very soon do if they could get at each other, but the bees will not allow that. If there is to be another swarm, only one of the young queens is allowed out of the cell, and the others are detained, a bee sitting over the mouth to keep them in.

July.—If the weather is fine, this is a time when the storing of honey goes on at a great rate. In a strong swarm they will collect from 4 to 6 lb. a-day. Toward the end of the month the drones will be turned out of the hive by the workers, and allowed to perish from hunger and cold. Two bees may be seen coming out of the hive, one on each side, holding on to the wings of the poor drone, which they very soon push over the flight-board.

August.—At the beginning of this month some honey will yet be stored; but towards the end of it, if honey becomes scarce from several swarms being about, the bees will take to robbing one another. A bee will go to another hive and try to slip in by the side of the entrance; and if he can evade the sentinels which are always posted about, he will soon come out with a good load of stolen honey. If once an entrance is secured to a hive, the bees of that hive seem to become quite demoralised, and give up to a great extent trying to defend their stores. With bees the rule seems to be, Get honey—honestly if you can, but in whatever way, get honey! This the strong swarms do by robbing their weaker neighbours; and they do not take a little, but clear them out of everything they possess.

September, October, November.—The bees now prepare for winter by closing up every crack or hole in the hive except the entrance, which they do with a gummy substance collected off the buds of trees.

Very much might still be said about bees, but I must now bring my remarks to a close, and may have something more to tell about these most interesting and industrious creatures at another time.

III.—In Memoriam: *ANDREW MOFFAT.*

BY MR JOHN LINDSAY.

(*Read Nov. 25, 1896.*)

THE announcement made by the President at the meeting of the Society on October 28, 1896, that our late Secretary, Mr Moffat, had died on the previous evening, came with the shock of a sad surprise to all the members. Though it was known to many of us that he had been in poor health during the summer, yet he seemed to have regained in autumn his wonted vigour, and indeed spoke of himself as feeling better than he had done for years. His school duties had been resumed at the beginning of the session, in October, and all seemed to be going well with him. But on Sunday, October 25, he again began to complain of feeling ill; was worse on the next day, when the family doctor was summoned; and passed away peacefully on the evening of the following day, Tuesday, the 27th. The immediate cause of death was the rupture of a blood-vessel in the region of the liver. On Friday, October 30, he was laid to rest in Warriston Cemetery. At the funeral the Society was represented by Dr Davies, the President, and by Dr Watson, Past President.

Andrew Moffat was born at Leith on the 20th February 1832. The first school he attended was one well known in Leith at that time and for years afterwards as "Walker's School"; but he soon quitted it for Bathgate Academy. There he made rapid progress, leaving the Academy at the age of fourteen as mathematical dux of the school. He next proceeded to the Royal High School, Edinburgh, then under the rectorship of the well-known Dr Leonard Schmitz, where he remained two years, matriculating at Edinburgh University in 1848, at the early age of sixteen. During his University course he attended the classes of Humanity and of Greek, taught respectively by Professor Pillans and Professor Dunbar; the class of Logic and Metaphysics, taught by Sir William Hamilton; that of Mathematics, by Professor Philip Kelland;

of Moral Philosophy, by Professor John Wilson ("Christopher North"); and of Natural Philosophy, by Professor James David Forbes, afterwards Principal of St Andrews University. These were men, most of them, of European fame as teachers and scholars, and there is evidence to prove that our young student profited largely from their prelections. As showing his early taste, also, for music, which was all his life so much of a solace and a delight to him, it may be mentioned that amongst his class tickets is one showing that during the university session of 1849-50 he attended the lectures of Professor Donaldson on the Theory of Music.

It being the custom at that time for students not to seek graduation, Andrew Moffat, now twenty years of age, left the University without a degree, but with a well-stocked mind as the result of this careful training, and he proceeded at once to open a school in his native town. In this sphere of duty the next fifteen years of his life were spent, his school becoming somewhat famous in the town, until in 1867 he accepted the post of Head-Master of South Leith Parochial School. When the Education Act came into force, and Board Schools were gradually erected, this parochial school ceased to exist, and in 1878 Mr Moffat secured the appointment of Arithmetical Master in George Watson's Ladies' College. Here the rest of his life-work as a teacher was accomplished, and in this favourite branch of education in which he had gained his first laurels as the dux of Bathgate Academy more than thirty years before.

But it was not only as an instructor of youth in the day-school that Mr Moffat put forth his energies: during many years he laboured in connection with Sunday-school and Bible-class and mission work, in all of which he was most successful. For twenty years, also, he was an office-bearer in Great Junction Street U.P. Church, Leith, and was presented with a piece of silver-plate and a purse of sovereigns in acknowledgment of his services as session-clerk to that congregation.

It was, however, as the Secretary and Treasurer of this Society that most of us knew Mr Moffat best. The Society was founded as the Edinburgh Naturalists' Field Club on June 2, 1869, and between that time and December 9, 1873, when Mr Moffat was appointed its Secretary, no fewer than six secretaries had already been in office.[1] Mr Moffat resigned the united offices of Secretary and Treasurer on October 26, 1894, so that for the long space of nearly twenty-one years he had performed these duties for the Society, and was thus intimately acquainted with its affairs during all that time. He had been a member of the Society for about a month only when he was asked to undertake these services: his membership and secretaryship were therefore of almost equal duration.

Of sterling probity, Mr Moffat was also methodical and painstaking in every duty he performed. He was a born leader, and generally succeeded in infusing some of his own enthusiasm into those who rallied round him. His attainments as a field-botanist are known to all the members of the Society. He had a wide and an accurate acquaintance with our native plants, and there were few localities in Mid-Lothian into which he had not penetrated in pursuit of his favourite study, though often going much farther afield. The herbarium he has left is very complete and extensive; and a beautiful collection of mosses attests his knowledge of this department of botany.

While Mr Moffat did much to increase the usefulness of the Society, there can be no doubt that he too was a gainer from his close connection with it. His prominent position in it for so many years gave an impetus to his own leanings towards the study of Natural History, and he spared no efforts to gain some proficiency in such branches as palæontology, entomology, and practical microscopy. Amongst the 3000 volumes which comprise the library he formed, there are many bearing on his favourite pursuits, as well as works in classical and general literature. In one of the press notices of Mr Moffat which appeared at the time of his death, there is a very pleasing reference to a scene which was by no means of unfrequent occurrence in the Ladies' College at George Square. The arithmetical master is there depicted as "off duty," and surrounded by a bevy of fair maidens, to whom

[1] The following are the names of the gentlemen who have filled the office of Secretary from the founding of the Society, with the dates of their appointment: Mr W. C. Smith, June 2, 1869; Mr T. Edmondston, June 9, 1869; Mr Andrew Taylor, October 6, 1869; Mr John Brown, November 29, 1871; Dr Hoggan and Mr John Walcot, interim secretaries; Mr A. Moffat, December 9, 1873; Mr A. B. Steele, October 26, 1894.

he is giving the names and pointing out the characteristic features of the wild-flowers held in his hand, and which had been brought by the young ladies themselves in order that they might enjoy this extra lesson. With recollections of happy summer hours spent with him in field and wood and by the sea-shore, it is in this connection that many of us would like best to remember our late respected Secretary.

When Mr Moffat resigned the secretaryship of the Society two years ago, the Council, besides electing him an Honorary Member, resolved that his portrait, with that of Dr Sprague —to whom also the Society owes much—should be placed in the forefront of the current volume of the Society's 'Transactions,' and this accordingly has been done. Future members may thus gain some idea of the appearance of him whose memory we now desire, by this memorial sketch, to perpetuate. But his commanding figure and his genial presence, which could be sufficiently severe on occasion, will not be soon forgot by any of those who either worked alongside of him or came frequently in contact with him.

Mr Moffat is survived by his wife, two sons, and two daughters.

At the meeting of December 23, 1896, Dr Traquair delivered an address, with lantern illustrations, on "Extinct Birds," which was much appreciated by the members. At the same meeting a paper on the Flora of Inchcolm was read by Mr C. O. Sonntag, whose death on March 4, 1897, the members of this Society, in common with many others who knew him, greatly deplore. The above paper would have found a place in the Society's 'Transactions' could it have been secured, but amongst the mass of MSS. left by Mr Sonntag it was impossible to identify it.

IV.—*FLAX* (LINUM USITATISSIMUM).

By Mr WM. FORGAN.

(*Read Jan. 27, 1897.*)

The object of this paper was chiefly to exhibit specimens of a few of the articles in everyday use in our households, and specially one article of headdress now rarely worn by women, at least in the Lowlands, all of which were manufactured from flax. The botanical name of the plant, *Linum usitatissimum*, simply means the most common lint or flax. A description was given, chiefly from the writer's personal knowledge, of the cultivation, growth, and after-treatment of the flax, both in the field and in the manufacture of it into linen yarn. Special reference was made to the weaving of it into cloth, and a few reminiscences of the handloom weavers of fifty and sixty years ago were given. Their poorly-paid work, the hardships they suffered, and their uncomplaining conduct in the most trying circumstances, were alluded to. They were practically masters of their own time, and this led them to form strong opinions on the matters which might be agitating the public mind.

A number of specimens of linen cloth were shown, procured by Mr Adam, a member of the Society, from manufacturers in Dunfermline. The writer made special reference to the "curch" or "curchie," at one time worn by women as a covering for the head, but now almost never seen. This term appears to be a corruption of the word *couvrez-chef.* It consists in taking a square of cloth of any kind, folding it once diagonally, and then, as a headdress for old women, tying the two acute ends of the double triangle, thus formed, under the chin, allowing the obtuse-angled portion to cover the head. Young women tied the two ends at the back of the head by passing them behind the ears. All wives of commoners were ordained by a statute of James II., just about four hundred years ago, to wear "curchies." Sir Walter Scott, whose knowledge of ancient Scottish customs was so extensive, alludes to them in 'Old Mortality.' It will be remembered that when

Mause Headrig was fleeing from Claverhouse's dragoons she scrambled over a dike, and Scott says that in doing so her curch flew off. Indeed the "curchie" forms the basis of one of our Scottish proverbs—"Cleanliness is couthie, as the wife said when she turned her curchie."

The article with which this paper had chiefly to do was, however, not the "curchie," but the "sooback" or "froudie." Two of these were exhibited, both over one hundred years old. One of them was a widow's, with a black band of velvet over the top from immediately behind the front, down on either side to the chin. The second one was made of finer material, and was worn underneath the other when the wearer was at kirk or market, or visiting friends. The "sooback" may still be seen in some of the Western Highland districts, but it has long ago almost entirely ceased to be worn in the Lowlands. The last of them the writer saw was about the fifth decade of this century.

A description was given of the dress worn by a woman along with the "sooback." The paper contained many allusions found in Scottish poetry to lint and the other matters treated of.

V.—*THE MAGPIE.*

By Mr A. CAMPBELL.

(Read Jan. 27, 1897.)

Since "trifles make the sum of human things," I am going to add a trifle to the general sum by giving a short biography of a tame magpie. As a preface, I may mention that the most of what I am to read now was written in an idle hour some ten years ago, and that it was never intended to be seen or read by any one except myself.

This magpie was bred in the top of a tree growing on the Binn Hill in Fife, well known to geologists as the remains of an ancient volcano. Its birth was not registered, so I am unable to give day and date. It was brought up by the parent birds in the usual way of magpie infancy until fairly feathered and able to fly. Being evidently adventurous, the youth, on a day of sunshine, left his home, perhaps a little too soon. Be that as it may, he took wing, but so wearied himself that he became an easy capture to some boys who were out in search of adventures — and birds. While the youngsters were on their way home with their captive I met them, and offering a silver sixpence for the bird and twopence for carriage, my bargain was safely delivered at my house. There he was duly installed in a large cage or birds' cottage, and offered meat and drink, but, being a captive and a stranger in a sorrowful mood, he took very little of either.

At this stage in his history I thought it necessary to give him a name, and I dubbed him Jack. Bird and owner became better acquainted, and Jack got quite familiar with his cottage, took food, grew more and finer feathers, increased in size, and developed what might be called reasoning powers of a high order in the avian family. He occasionally got the run of the kitchen, where he made the acquaintance of Mary the cat, dining out of the same dish with her, and frequently setting her to the right about in a very unceremonious manner—often rewarding her good nature by pulling her tail, and otherwise disturbing her slumbers on the kitchen rug before the fire. In a short time he got out, and came in again by door or window without any trouble. As he grew in days his Magpie nature grew with him. But, to his credit or discredit, he developed one special talent. He became an adept in the art of "conveying," as mine Ancient Pistol called it. Coins and trinkets were his favourites, and his neatness in "conveying" these things was only equalled by his neatness in concealing them. His roguery in this line was the cause of many a search for "lost property."

I shall give one instance of his method of procedure. One day my wife had occasion to go out for some things, leaving a purse with three half-crowns in it on the table in the kitchen. Jack was in at the time, and saw the proceedings. When she came back in about five or ten minutes the purse was on the floor open, and the half-crowns gone. After a diligent search, two of the coins were got, but the third was nowhere. A few days after I gave him a penny, over which he chuckled in his own way. I then snatched it from him. There and then he went to a small opening in the seam of the carpet, pulled out the half-crown, held it up in his bill as much as to say, "There it is, and you could not find it." I rewarded him with a bit of an egg, a favourite dainty of his at all times. Speaking of his fondness for eggs, I may give you a list of some of the articles of food that constituted his bill of fare. Eggs, as I have already mentioned, but only the yolk. Bits of beef and mutton, raw or boiled, rabbit, chicken, cheese, bread and butter, bread in milk, potatoes, were all heartily eaten when Jack was hungry. Fish he avoided as poison—even in Lent. What I give above were his civilised dishes. His wild or savage food consisted of sparrows, mice, beetles, grubs, flies, wasps, &c. His method of dealing with the wasp was cautious and curious. The insect was seized crosswise, the abdomen squeezed through the bird's bill in a sliding shifting manner, when, snap! and the poison-bag and sting were dropped, and the remainder swallowed. His vegetable fare consisted of green pease, gooseberries, and currants, and the indigestible portion was ejected in pellets. In the summer he made the garden his quarters, as it afforded him food and shade; and being of a selfish nature, he did some good service by chasing other birds away from his own delicacies. There one day I saw him kill a young sparrow, and he seemed to rejoice very much in his own fashion over the dead bird. He carefully buried it in the loose dry soil, and next day he raised the dead and made a hearty meal of it. I may here give another instance of his habit of hiding or burying food for another day. In fact, this bird was far more provident in this respect than thousands of the lords of creation, who "take no thought for the morrow," with the result that we have to pay their bill in the poorhouse and their burial through the rates.

But to proceed with Jack. One day the cat was playing with a dead mouse on a plot of grass before the window. The bird eyed the play, and coveted the mouse. He first attacked the cat in front, but every time he came near the armed claw and paw were raised ready to strike. He knew what that meant. Then, like a skilful general, he attacked puss in the rear by giving her tail a strong pull. Of course the cat turned round to defend herself, and then Jack flew to the front, picked up the coveted mouse, and off to the top of the house rejoicing. I can yet see the searching look all round that the poor cat gave for her prey—which was nowhere to be found. The mouse was afterwards buried in the garden, as I saw Jack taking it up some two days after. I shall give one instance of his roguish nature when dealing with other animals. I saw him one day alight on the back of a fine fat sheep in a field. He began by snapping up the flies that flew about or alighted on his host. After satisfying himself, or clearing off all the flies, he walked forward on the sheep's back and pulled an ear with all his might. The poor beast shook its head and gave a look round to see its tormentor flying away. I thought the bird's way of rewarding kindness in this manner was peculiarly Milesian.

But he did not confine his tricks to cats, dogs, and sheep. He learned to imitate what I might term the "call back" whistle that is used by country people when they want to stop or call back some person. He would sit on a wall or paling, and when a man had passed some 200 or 300 yards, then forth went a whistle. Naturally the man looked back, but seeing no one in sight walked away; but the whistle was repeated so long as any attention was paid to it. His playing of this trick on a tramp amused me very much. Jack was perched on a chimney-top at the side of the public road. The tramp—a big, lumbering, lazy-looking fellow—was going east, and three or four young women passed him on a parallel road, going westwards. After the fellow had proceeded some distance the whistle sounded, and Mr Tramp looked back. Nothing to see—he moved on. A second whistle, with the same result; then a third call,—but this time he saw the cause. I will not repeat here the half-subdued blaspheming that came from that man when he discovered himself to be, like Herod, "mocked."

In common with many other bipeds, this bird had his likes and dislikes, his loves and his hates. He was particularly fond of two of my daughters, while a third he hated with the hatred of a good hater. She tried in every possible way to make friends with him by caressing him, giving him food, &c., but all to no purpose. I could never account for his antipathy towards her. He showed the same disposition to children that came about the door. Some he was quite friendly with; others he chased away, striking their legs with his bill and scolding them in an unknown tongue. He was found frequently in the school playground, and he enjoyed a country stroll like any field naturalist—especially in my company or with my daughters. He would fly some distance in front, light on a rail, tree, or wall, and wait his companions' coming. Then in the summer-time the swallows annoyed him by trying, as I thought, to strike him with their wings. His method of protection was to seat himself on the second spar from the top of a fence or gate, where the swallows would not pass through on the wing. One Sunday he followed my wife and daughters to the church. He did not venture in, but took his stand in one of the windows and wisely looked inside. I could never discover that his connection with the church in this case improved his morals or his manners. But perhaps the same may be said of many others who frequent the synagogue — from the time of the Pharisees of Judea to their counterparts of the present day.

Although this bird would wander with me anywhere on the low ground, yet he never would go with me to the hills or approach a wood where wild magpies were. I could not give any reason for this, until I mentioned the fact to my brother, who happened to be on a visit. "Oh," he said, "I can explain that: he would be chased away by the wild birds, if he has not already been chased by them. When I was a young man residing at Blair Athole I had a tame raven. He used to go with me to the hills in Glen Tilt, but whenever he saw any of the wild ravens he took wing, strong and straight and swift, for home. But once he went too far,—tried to make for shelter, pursued by a number of the wild birds, was overtaken and killed." I believe this accounted for Jack's antipathy to the hills and the woods.

With the more sociable rook it is different. A tame rook lived in the village of Letham, in Fife, for many years. This bird used to go into the fields in the spring-time, take unto himself a wife, assist to build the nest, and rear the family in Melville House policies, and, when all his duties were over, return to his friends in the village for the rest of the year.

Jack was very fond of a bath, and had to get a shallow basin filled with water every day; and what a splutter he made! Then he would go to the front of the kitchen fire, stretch out one wing and then the other, until he got himself dried and dressed to his entire satisfaction. In the summer time he would perform his ablutions in a stream in the fields, if it suited his taste.

The superstition connected with magpies is by no means extinct in this country. One day I saw a woman coming along the public road. Jack was sitting on a wall a little out of sight, and when the woman was opposite he sent out one or two *Pica* words. The poor woman gave a scream, followed by some exclamation—malediction or benediction, I did not catch which—and then ran as if she had heard the roar of the lion or the howl of the wolf, instead of a chattering magpie. When I parted with my feathered friend, I was gravely told by a very decent and pious woman that I had done well in giving away such a bad and unlucky bird. So you see that Ignorance and her daughter Superstition die hard, even in Presbyterian Scotland, let alone Catholic Ireland or Spain.

At this meeting Dr Watson read a paper entitled "Remedies for Snake-bite," being a continuation of his former communication, "Recent Researches on Snake-Poison." A cordial vote of thanks was awarded Dr Watson for this second paper on the interesting subject of snake-poisoning.

VI.—*BIRDS OF KINTAIL, ROSS-SHIRE.*

By Mr ARCHIBALD CRAIG.

(*Read March 24, 1897.*)

In January 1889 it was my privilege to read before the Society a paper treating of the scenery and archæology of Kintail and district, so that it will be unnecessary, save very briefly, to refer again to the former, except in so far as it may help to indicate the nature of the country inhabited by the feathered fauna about to be mentioned. The four parishes embraced in the locality are Kintail, Glenshiel, Glenelg, and Lochalsh,—the last, as the name denotes, lying along the shore of that arm of the sea. Not far from the village of Dornie, Loch Alsh divides into two other lochs, called respectively Lochs Duich and Long, the former being wide, and terminating at the base of a most magnificent range of mountains, conical in shape, known as the "Sisters of Kintail," and averaging about 3700 feet in height; the latter, again, being narrow and sinuous, running inland for about six miles close to a place called Killelan, where, as the name implies, a religious house of some kind must have existed in bygone days, although no trace of it seems to be left at the present time. Along the sides of all these lochs are scattered numerous crofting and fishing clachans, the more important of which are Dornie, Ardelve, Bundalloch, Letterfearn, and Sallachy. The scenery is of the wildest and most romantic type, Kintail in particular being about the most splendid piece of landscape of which the Western Highlands can boast, and that is saying a good deal. Prior to the disappearance of the herrings from Loch Duich many years ago, Dornie was a thriving fishing-station; but owing to the loss of that industry it has, in common with the other townships, retrograded sadly, consequently many of the inhabitants are excessively poor, and there is a lack of suitable employment for them,—the soil, save in a few isolated instances, being thin, and very unremunerative to cultivate. Smuggling in the old days was rather a profitable business; but of late years whisky-stills are few and far between, the preventive staff having by energetic measures rooted out the most of them. The bulk of the property now belongs to Sir Kenneth Matheson, but formerly was a possession of the Mackenzies of Seaforth, whose ancient and ruined stronghold, Castle Donan, still stands upon a rocky eminence, which at high tide becomes an island, within a few hundred yards of Dornie. In some parts, for instance about Balmacarra and Inverinate, there is a considerable quantity of wood, but in most districts trees are sparse, and scattered in irregular patches along the hillsides, so that the variety of the smaller sylvan fauna is not great; but the shores afford good feeding-ground for maritime species—to wit, herons, gulls, oyster-catchers, redshanks, and so on.

Enough has perhaps been said to give you a cursory idea of the country, so attention may now be drawn to the bird life. Commencing, as in duty bound, with what are sometimes termed the nobler order—viz., birds of prey—it is regrettable to record that, thanks to the relentless warfare waged by game-preservers, the number of these is rapidly diminishing, and in my own experience I can only verify the existence of three—the peregrine falcon, kestrel, and sparrow-hawk, and, from report only, the merlin. The last has not been identified by me, but I am led to understand it occurs sometimes. The kestrel is not so very uncommon, and a pair may almost always be seen in the vicinity of a huge, rocky, and precipitous knoll, about two miles up the east side of Loch Duich. From the summit of this knoll a most comprehensive view is obtained of the loch, and what is locally known as the "Fold of Kintail," a hollow opening surrounded on three sides by the lofty mountains indicated previously, and designated the "Five Sisters." This pair appear to nest on the inaccessible face of the rock, quite safe from intrusion. Sparrow-hawks breed on a range of cliffs facing the south side of Loch Alsh, about midway between the ancient Broch Caisteal Grugaig and a farmhouse called Ardintoul. Owls are not very common either, although the tawny species may be heard hooting at nights in the woods at Totaig Ferry, and also about Inverinate and Balmacarra. The barn owl is the only other existing species known to be resident: it nests in the same rock as the kestrels.

Turning to the Corvidæ or Crows, we find this genus well represented. Ravens, though by no means plentiful, still breed in certain quarters, notably at the landward end of Loch Long, and on several occasions have been observed by myself flying at an immense height over the muir which lies between Loch Alsh and Loch Carron. The carrion crow is not so abundant as his congener the grey bird, which in winter and early spring swarms on the coasts, picking up its food among the sea-ware at low tide. Those birds are exceptionally cunning, and defy all the efforts of the keepers to exterminate them,—the shores being bare and open rendering it a most difficult matter to approach within gunshot, the only chance being to fire off a boat. Not much can be said in favour of this species; it is undoubtedly destructive to the eggs of grouse and other feathered game, as well as to sickly sheep and lambs. It is not ornamental, and not particularly useful, except perhaps in so far as its propensity goes for devouring the carcasses of dead sheep or other carrion. In summer they almost entirely desert the lower regions, having departed to the muirs and hillsides where nesting operations are progressing; but in autumn, reinforced by the young birds, they begin to show face in great numbers. Rooks are, as elsewhere, abundant, there being a few rookeries in the district; and jackdaws are far from scarce, their chief abiding-place being the old castle of the Mackenzies, but they also breed among the cliffs.

In a very old and quaint ornithological work I read lately of a novel plan for catching crows and pigeons, but whether feasible or not is more than I can say. Briefly put, the *modus operandi* is as follows: Make up several strong brown-paper bags in shape like sugar-loaves, covering the insides with birdlime, and filling the conical end with corn; lay these on the ground where the birds are in the habit of feeding on the young grain, and when they attempt to pick out the food, the bags stick to their heads. According to this chronicler, they get so alarmed that they fly to a great height, and, after exhausting their strength, tumble to the ground, when they fall an easy prey to the artful fabricator of the bags.

Leaving the smaller fauna, such as thrushes, finches, &c., until later on, let us turn for a few minutes to the sea and other shore-haunting species. Just opposite Dornie, at the sea end of a long spit of land called the Aird, is a flat grass-grown piece of ground which at high tide is almost entirely covered with water, but at low ebb is surrounded by a long stretch of tangle-covered beach. This is probably the best place to observe birds, but in order to do so satisfactorily a boat is essential—in fact, the latter is a *sine quâ non* if the district is to be properly explored. One of the most familiar objects around this island is the heron. Great numbers of those long-legged birds may be seen standing like mutes at a funeral in the shallow water, waiting with exemplary patience upon the unwary fish who may approach too near the shore. Unless they snatch occasional snoozes between their meals, one wonders if they ever sleep at all, as during the night as well as the day their peculiar and unmelodious "squaak" may be heard all around in close proximity to the water. Many must breed in the neighbourhood, but apparently nesting operations are not conducted in large colonies, as is their wont in many places. More than likely they build in desultory fashion, among the trees that here and there cover the rock faces—spots well-nigh uncomeatable to human beings. At the far end of Loch Long there is a very high and almost unclimbable rock where they used to nest, and that they do so still I am informed on credible authority. Here also is the home of the ravens. Another site is at Lochnabeast, near Kyleakin, in the island of Skye. Another very prevalent species in winter is the curlew, or whaup, to give it its Scottish cognomen. A most wideawake bird is this: not much chance of getting within shooting range of him, and, what is more, he seems to act in the *rôle* of sentinel to all the others, as the moment he detects the least danger his long quivering signal-note puts the rest on the alert, and gives timely warning of the approach of an aggressor. The peewit also tenants the shores, not, however, in any very great numbers, but its *confrère* the golden plover seems unknown. Two beautiful species interesting to watch are the oyster-catcher and redshank, the former laying its eggs on the shingle above high-water mark, while the latter retires inland to boggy ground for the purpose of rearing its brood. The local name for the first-mentioned is mussel-sucker, which seems a much more sensible name than oyster-catcher, as even if these bivalves were plentiful, it strikes one as being impossible that this bird could open the shells, and I must confess to being rather sceptical of their ability to easily gaining access to the mussel itself. The pretty little ringed plover also makes this part its abiding-place, and their eggs may frequently be noted in the same locality as the sea-pyets. Purple sandpipers are by no means strangers, and a pretty sight it is to watch them running in little bands among the stones fringing the sea, following the receding waves, in colour so similar to the ground as to render it no easy task at times to distinguish them, were it not for the guidance of their melancholy "peepy" note. One is almost inclined to think that these birds may breed here, as they are identified well on into May, but notwithstanding diligent searching, I never could find the nest. A female shot in May 1896, when dissected, had all the appearance of being ready to lay, but on returning next day to see if any signs of nidification were visible, the small flock had departed, and during the remainder of my stay did not return. That summer migrant, the common sandpiper, may also be found everywhere in favourable habitats, and, no doubt, other members of the Scolopacidæ, but I have been careful to exclude any species whose existence cannot be verified from my own observation. Strange to say, dunlins do not seem to put in an appearance in Kintail, although the ground looks suitable. The little grebe is a constant resident, and, both on Lochs Alsh and Duich, razorbills and common guillemots may be observed alternately floating and diving on the water — the vulgar name "dooker" being indiscriminately applied to both species by the natives. Another most interesting species is the little auk, not by any means numerous, but identified by me on several occasions. Both cormorants and shags are numerous, the latter being the most familiar, and during this last winter in particular the numbers were quite phenomenal. A favourite resting-place is a small rock in Loch Alsh, and dozens at a time often sit there. Those birds fly a long way inland, and isolated individuals are come across by the burn-sides miles away from the sea. They are rather hard to shoot while swimming, as the bodies are entirely submerged, leaving only the head and a small portion of the neck visible, so that when a lot of them congregate together, they form a striking resemblance to a series of umbrella-handles bobbing up and down in the sea. The moment the gun-flash is observed they give a comical kind of jump and dive below the surface, to reappear at a long distance from the spot where they vanished. If not quite dead when picked up, great caution is required in lifting them, as they are capable of giving a villanous bite. Gulls are represented by the following: common gull, black-headed kittiwake, herring gull; and in stormy weather the lesser black-backed species occurs in limited numbers. Two others may be included in the list —viz., the skua and great black-backed gull, rare visitants, however. When shoals of herring come up Loch Alsh, as they did in erratic fashion within the last few years, their presence is readily detected by the immense flocks of gulls following their progress, their querulous and excited cries having a peculiarly eerie effect when heard at the gloaming. Common terns also join issue with them, and most graceful birds they are to watch during flight.

Various kinds of ducks, mallard and teal especially, frequent the shores of the little island in question, and in extra severe weather rarer stragglers are driven inland, more particularly when the wind is blowing from the west or south-west, which are the "airts" from which most of the worst storms visit the district. A genuine westerly gale here is something worth looking at, provided the spectator has the shelter of a roof over his head, but is the reverse of pleasant when it catches one at sea or among the mountains. There is no mockery about its intentions then: the sight is certainly impressive, but as it is attended in the latter circumstances by positive danger to life or limb, the victim may readily be excused for not appreciating its efforts. Some seasons small bands of wild swans fly across country at an immense height in the air, never seeming to alight anywhere in the neighbourhood. Two very well-known species about the loch margins are the meadow and rock pipits, as also the pied and grey wagtails; and among the lesser fauna seen at the proper times of year may be instanced the skylark, common, reed, and yellow buntings, chaffinch, greenfinch, bullfinch, robin, redstart, house and hedge sparrows, redpole, mountain linnet, spotted fly-catcher; the three chats—stonechat, whinchat, and wheatear—the first-named being found sparsely at all times. Snow-buntings enliven the scene during exceptionally prolonged winters, but not in such large bands as in some other parts of the North, or even in the easterly regions of the lowlands. Starlings, from being at one time very rare, are now, as elsewhere, seen in fair numbers, this species having multiplied more rapidly than almost any other kind that could be specified. Crossbills are seldom identified about Kintail, but in the adjoining parish of Glenelg I have observed small flocks. This is one of our most interesting native species, but having upon a previous occasion written rather a long account of it for the Society, I need not trespass further on your patience.

Running rapidly over the others still to notify, we find the Turdidæ or Thrushes consist of the missel, blackbird, mavis, and ring ousel; and in this connection may be included the lively water ousel or dipper; the Sylviidæ or Warblers, consisting of the sedge, whitethroat, wood, and willow kinds. Gold-crests, wrens, and tree-creepers may also be included. The Paridæ or Titmice embrace the great, blue, cole, and long-tailed species; the three Hirundinidæ or Swallows, also the swift, are of course in fair evidence during the summer months; and game, as may be inferred, is an important item, the whole country, more or less, being let to shooting tenants. The chief species embraced under this category are grouse, ptarmigan, pheasants, woodcock, and more rarely snipe. To complete the list, there only now remain the following odd species: the cuckoo, wood-pigeon, and corncrake.

It cannot be asserted that Kintail, as a district, is rich in bird life, as many familiar in other parts of Scotland do not seem ever to put in an appearance. But this may be accounted for by the fact that the nature of the country is unsuitable to their habits; and, moreover, the comparative scarcity of wood diminishes the number of the sylvan-loving species.

I must apologise for the inadequate nature of this communication, but was in hopes of making the subject more interesting to the Society by narrating some of the curious and absurd superstitions about birds that prevail in this and other parts of the Highlands. Unfortunately, however, the want of Gaelic speech has been a great hindrance in their collection; but should I manage to gather sufficient to fill a paper, with your kind permission I may bring the matter under the notice of the Society at some future date.

VII.—*A BADGER COLONY IN DALMENY PARK.*

By Mr CHARLES CAMPBELL.

(*Read March 24, 1897.*)

In reading a short paper on the badger before this Society, I cannot claim to have much that is new to say regarding this animal and its habits. However, I shall mostly confine my remarks to what has come under my own observation in the woods of Dalmeny, and it may not be entirely without interest in showing how a colony of these animals may exist in a much frequented neighbourhood, and still escape observation, or only come under the notice of such as may seek them out.

For some years back, paragraphs have been appearing in the papers with, I think, increasing frequency, relating the capture of a badger at some part of the Lothians or neighbouring counties. It was only at the beginning of this month that a letter appeared in the 'Scotsman' giving an account of the capture of a badger near Roxburgh. Some of the nearer of these records I am inclined to believe may be set down to animals which have migrated from the colony which I will now speak of—for, although it still seems to hold its own, it has not increased of late, and the question of food-supply alone would cause some of the younger generations to seek a new home.

In a secluded corner of Dalmeny Park there has existed for some years now a colony of badgers. Their history, briefly related, is as follows. In 1881 the Earl of Rosebery brought a pair of badgers from the south of England, and had them liberated in Dalmeny woods. Nothing more was seen of them inside the policies, but a badger killed at Hopetoun shortly afterwards was supposed to be one of the pair. In 1889 three others, one male and two females, were brought to Dalmeny. Profiting by experience, these, instead of being liberated in the open, were let into an old fox-earth. Here they at once took up their abode, and seemed to adapt themselves to their new surroundings. The earth is situated in the side of a ravine some few hundred yards from the sea-shore. The soil, being loose sand, is most suitable for burrowing. The trees growing near are beech and Scotch fir, with some young birches in a strip of marshy ground opposite. In the summer the undergrowth is an immense bed of brackens, over six feet high, and growing so close and thick as to be not easily penetrated. This forms an excellent cover for the badgers, and one can trace the various runs through it very distinctly. Some foxgloves growing near give a variety of colouring to the spot.

The entrances to the burrow itself are partly hidden by some sapling elder-trees. In winter the brackens, though faded and broken down, still serve somewhat to screen the movements of the animals, while their roots furnish a portion of the winter diet. At present there are five entrances to the original burrow, or rather where there was only one opening at first there are now five within a radius of as many yards. This is rather in contradiction to most text-books, which are unanimous in describing the domicile as having but a single entrance to several tortuous passages or chambers. Tons upon tons of sand have been thrown out during the last seven years, and each season sees the mound increasing. A common proverb is responsible for the idea that the badger is an offensive animal, but when at liberty it seems to be a model of cleanliness. Every season, about the month of March, the winter bedding is thrown out and a supply of clean dry brackens taken in to form the nest. But the badger is not content with a spring-cleaning alone, for at the beginning of winter the nest is again cleared out, and fresh bedding for the winter taken in.

So far as I can learn, the badger seems to be comparatively harmless to game—at least the gamekeeper, in the absence of positive evidence to the contrary, is inclined to give it the benefit of the doubt. I have seen torn rabbit-skins on several occasions lying at the mouth of the hole, but the killing of a rabbit or two is not regarded as a serious crime. One of the most interesting facts in connection with the food-supply of these animals is the manner in which they dispose of all the wasps' nests which they find in the ground. In the summer, at the edge of the carriage-drives and along the grassy avenues, every now and then you can see evidence of their work. A circular hole neatly scooped out to the depth of about a foot is all that remains of the wasp's bink. The comb has furnished the badgers with a dainty meal.

Whether it is a matter of imagination or not, it seems to me that wasps have not been so plentiful in Dalmeny since the badgers began to prey on them.

Although the badgers have at various times opened new burrows in different parts of the woods, they never seem to have taken up their abode permanently away from the original burrow. On the opposite sides of the gulley from where this earth is, there are at present two holes which seem to be jointly inhabited by foxes and badgers, as far as can be seen from the footmarks.

The badger is known to leave the policies, as they have a well-beaten track underneath a gate leading from one of the grass-parks on to the Queensferry Road. They are never seen during the day. At night, however, they are sometimes encountered by a coachman who lives in a cottage situated in a lonely part of the woods in that quarter. From his experience badgers do not seem to have a very keen sense of sight or smell, as if they happen to be first noticed and the person stands quiet they will come straight on, much in the same manner as a hare will do.

Some instances have occurred of rabbit-traps being carried away by badgers caught in them. In opening a drain once, the skeleton of a badger with a rusty iron trap still fixed on the bones of one of its legs showed how it had come to its death. A young cub was once caught, and after being kept for some time was liberated. Another time a full-grown badger was caught, and its foot had to be cut off before being set free. The marks of the stump leg can occasionally be seen in the soft sand at the mouth of the burrow, showing that the animal is still alive and well.

On the 21st December 1896 a young badger was discovered in an outhouse at the Leuchold, the residence of the estates factor. The coachman had noticed the footprints in the snow for some distance, and on going into this shed was surprised to see a badger lying curled up asleep among the straw. He was a bit frightened at first, but soon saw that something ailed the animal, and he went and got some milk for it. The badger did not exhibit any fear, but licked up the milk, and seemed to revive after it. It afterwards partook of any food its custodian gave it, and would come and meet him when he entered the shed by himself. When I saw it on Sunday the 27th December, it was still in the straw-shed, and had just been having its breakfast of milk and fish. It was a chubby little animal, scarcely half grown. Its coat was of a beautiful silver-grey colour, and the white markings on its face seemed to be more pronounced than is the case in the adult animal. In conversation with Mr David M'Diarmid, head gamekeeper on the Dalmeny estates, regarding the unexpected appearance of the badger, he was of opinion that the old badgers had hunted it out of the burrow, and that cold and hunger had driven it to seek shelter, and rendered it tame. This interesting little animal remained in its prison some time longer, but as it gained strength it seemed to grow more restless, and one morning was found to have escaped. Previous to this it had shifted its sleeping-quarters from one end of the shed to the other, and had begun scraping under the walls. While doing this, it must have been smelt by some of its kindred that had been prowling near, and aided in its escape by them, for on examining the hole by which the badger escaped, it was seen that most of the scraping had been done from the outside. Some days afterwards the escaped prisoner was seen playing about the shrubberies round the Leuchold walls with a little dog belonging to the establishment.

About the last week in January the weather again became stormy, with snow lying deep on the ground. This badger having once tasted the comforts of captivity, evidently did not relish being out in the cold again, for one morning he was found sound asleep in his old quarters. He was well taken care of, but shortly afterwards was found dead in his crib.

On the 23rd of January of this year I visited the badgers' stronghold, and found that the gamekeepers had, in anticipation of a visit from the Linlithgowshire Hunt, closed all the entrances to the burrow to prevent foxes seeking earth there. The badgers I saw had made use of a "pop" hole to escape from imprisonment. On going back a week later I found two of the entrances open. On this occasion there was snow on the ground, and I was able to trace the footmarks of the badgers a good distance through the woods. And here I would like to mention that the generally accredited theory that the badger lies dormant during the winter does not seem to hold good, so far as my limited observation of these animals goes. On the 14th of February the five entrances to the burrow were all reopened, and there were signs of considerable traffic. The quantity of brackens that had been trailed in showed the breeding season at hand. Sunday, the 7th March, showed more signs of traffic about the burrow than any previous visit this year. The last visit I paid was on the 20th of this month (March), when there was a lot of fresh sand thrown out, and as it was well padded with footprints it showed the stronghold to be in a thriving condition. I have never had the necessary enthusiasm to spend a night in the woods to watch their outgoings and home-comings, but possibly may try and do so this summer.

No notice of the badger would be complete without referring to the ancient sport of badger-baiting. In some old natural history books you will see a woodcut representing a group of sportsmen clustered round a barrel in which can be seen the figure of a badger grinning defiance at several irate terriers, whose rustic owners, armed with pitchfork and bludgeon, are stirring them on. This little picture speaks more eloquently than words of the light in which the badger was regarded in those days. From the Statistical Accounts of Scotland we can learn that with the increasing development of the country, and stricter views regarding the preservation of game, the badger gradually disappeared from places in which it formerly abounded, though it still managed to maintain a precarious existence in a few scattered strongholds, such as are still to be found on the banks of the Tweed. For a detailed account, however, of the history of the badger in the Lothians I would refer you to 'The Mammalian Fauna of the Edinburgh District,' by Mr William Evans, published in 1892. It is a pleasure to think that some landed proprietors now look with a more tolerant spirit on such animals as the badger and the wild cat, and are even found extending protection to them where there are any left to protect. The days of badger-baiting are now past, and we do not look upon it as the mere victim for a cruel sport, but as one of the most interesting of our British fauna, whose ancestors were in existence while the bear and the wolf roamed through our forests and the beaver haunted our streams.

VIII.—*SUPPLEMENTARY NOTE ON THE GREAT AUK OR GAREFOWL* (ALCA IMPENNIS LINN.)

BY MR SYMINGTON GRIEVE.

(Read March 24, 1897.)

To some of you it may seem a waste of valuable time to write anything more about the Great Auk or Garefowl, so much has been done to record all that is known about it. To those who are only slightly acquainted with the history of this bird, such an opinion would seem, no doubt, quite reasonable. But others who have given more attention to the subject are better informed, and are aware that from time to time discoveries are being made of remains under extraordinary circumstances that are of sufficient interest to cause columns to be filled in the daily press and magazines about the Great Auk. In addition, there is a constant change of specimens going on, principally eggs; and these need to be traced to new resting-places or they will be lost sight of altogether.

Certain purchasers, under some mistaken idea, are very reticent about the price they pay for alcine remains. If they fully realised the advantage to themselves should they or their heirs ever wish to sell their collections, they would only be too glad to have all the information that is known recorded, as the value of such rarities is thereby much enhanced. I am glad to be able to say that what I have just remarked refers to the very few, as in my large correspondence with possessors of such remains I have in the great majority of cases been furnished with the fullest information, for which I have to thank these collectors.

Since I read my last paper upon the same subject to this Society in November 1887, a number of events have occurred that are worth recording; hence I trouble you upon this occasion.

When the sale of the egg of *Alca impennis* Linn. which belonged to Mrs Wise took place on 12th March 1888, the egg was sold for £225, as mentioned in these 'Transactions.'[1] This

[1] See 'Trans. Edin. Field Nat. and Micro. Soc.,' vol. ii. p. 114.

sale created a great deal of interest at the time, and was referred to by all the leading journals. 'Punch,' in its issue of 24th March 1888, p. 153, thus refers to this event:—

A Golden Egg again.—Another Great Auk's egg has just turned up, been put up to Aukshun, and knocked down again, without being smashed, fortunately, frail a curiosity as it was to come under the hammer. Mr Stevens of King Street, Covent Garden, sold a very fine egg of the Great Auk for £225. . . . This one egg was ultimately taken to a good market, and was sold for the sum mentioned. We hope it has reached its destination in safety. An accident might happen from mere Aukwardness. Some of us will be wishing that we had a private Auk, of a sporting turn, who would lay heavily occasionally. We wouldn't kill him to see how the trick was done.

On 25th March 1888 Mr R. Scot Skirving sent me the following from his pen. He says "it is a mere pun." It also refers to the egg sold by Mrs Wise:—

"Mrs Wise, you were wise to keep open your eyes
To the value of Alca impennis:
Few eggs gain by keeping, whatever their size,
But Alca's will keep you in pennies."

At the exhibition of pictures at the Royal Academy, London, in 1892, was one by Mr H. S. Marks, R.A., named "The Collector's Treasure: The Great Auk's Egg." The picture is admirably drawn, but unfortunately the costumes of the two gentlemen who appear in the scene would lead one to believe they lived in the thirties of the present century, when eggs of the Great Auk were of comparatively little value, instead of in the nineties, when the eggs had become precious. Prints of this picture appeared in 'Royal Academy Pictures,' 1892, and also in the 'Illustrated London News,' 30th April 1892.

In the 'Zoologist' for 1895, p. 285, Mr J. Steel Elliot says:—

The old grey-bearded man Lachlan M'Kinnon, mentioned by Mr Dixon as having taken part in stoning to death a Great Auk on Stack-an-Armin, was, I am sorry to say, dying when I left the island. An interview with him would have been useless, as I was informed his memory had left him for some time. The natives told me of a ledge on Soa named after the bird, which it is said to have frequented in the breeding-season.

(See also 'Trans. Edin. Field Nat. and Micro. Soc.,' vol. ii. pp. 97, 98.)

An early notice and figure of the Great Auk, by Mr Miller Christie, F.L.S., appeared in the 'Zoologist' for 1894, p. 141. This article is well worth perusal, and gives a quaint reproduction of a picture of two *Alca impennis* Linn. as they appear in the 'Fourth Book of John Sellers, English Pilot' (London, folio), a work which went through a number of editions in the latter part of the seventeenth century and throughout the eighteenth. The first edition, which was published about the year 1673, does not contain the passage, which first appears (so far as I have been able to discover) on p. 17 of the edition of 1728. It occurs among some directions for sailing upon the coast of Newfoundland.

For many years past alcine remains have steadily increased in value, but the market, probably owing to the high prices such natural history relics realise, is a somewhat limited one. As in all other commodities, an increase in the supply at once depresses the market, and although such increases of supply of Great Auk skins, bones, and eggs must be in the nature of things very slight, still a much more violent fall in prices follows such slight increases than in any other wares I am acquainted with. For instance, quite recently the market in Great Auk eggs was depressed owing to the supposed possibility of a number of eggs in the collection of a deceased collector sooner or later being offered for sale. I have every reason to believe that the collection referred to will remain in the family who at present possess it, and there is no likelihood of its coming on the market. Since the above was written I have a letter from Miss Champley, Scarborough, dated 27th January 1897, who says: "I do not purpose at present selling my nine eggs of the Great Auk, and shall be glad if you will kindly state the fact."

To most people interested in natural history, it would seem that much more interest attached to skins, skeletons, or individual bones of the bird than to its eggs. The last teach little regarding the habits and structure of the bird compared with the others. Yet the prices obtained for eggs are about as high as those obtained for skins, and quite out of all proportion higher than any price obtained for skeletons or bones. At first sight it is difficult to account for this, but a little reflection will prove that a great many have room for oological collections when they have no room for stuffed birds; and to some who look upon Great Auk eggs more as curios than rare natural history specimens, the bones and skeletons, even if the latter were obtainable, savour too much of the graveyard for the tastes of the ladies of the household. These remarks, of course, only apply to private collections, but it is to such collections that almost all the Great Auk eggs offered at public sales during recent years have gone. The fact is, that even our great public museums have to stand aside when they have to buy against the offers of rich private individuals.

The eggs vary considerably in their markings, those with blotches being much more common than those with streaks or pencil lines. Some eggs have the markings only faintly seen outside the shell, and many eggs are more or less damaged. For instance, the Hill egg that came from Poole in Dorsetshire, and was purchased by Lord Lilford, and is now in the Cambridge Museum, has one end broken off, but is nevertheless a fine egg from its markings. The egg now in the possession of Mr Middlebrook, London (see p. 262), purchased at Stevens' Rooms, London, 27th July 1897, is also said to be slightly cracked. It is, however, believed to be a fine specimen.

I find the following in my diary, 20th May 1889, when I visited the National Museum, Smithsonian Institution, Washington, U.S.A., and was shown the splendid collections by my friend Mr F. A. Lucas: "I was taken by Mr Lucas to the egg-room. A young lady in charge most courteously showed me the egg of *Alca impennis* Linn. The egg has been much damaged, and is patched up with putty or stucco, tinted outside to make it approximate to the colour of the ground pigment of the shell. There has been no attempt to put on blotches or pencil lines on the artificially restored parts. Much of the shell has been broken away, at one end especially. The shell, to my eye, seemed very dirty, and I have no doubt a careful washing would quite alter the appearance of this egg, which may be described as a blotched variety not pencilled" (see p. 263).

In the fine collections in the New York Natural History Museum near the Central Park there is no egg of the Great Auk, but they have endeavoured to make up for this want with a model.

Since I read you my last paper, three previously unrecorded eggs have been discovered. The first of these was found in the collection of Mr S. E. Shirley, at Ettington Park, Stratford-on-Avon (see p. 263). It had been labelled as the egg of a penguin, and had remained unnoticed for some eighty years. The other two eggs were accidentally discovered at a sale, and their purchase created quite a sensation in oological circles in the spring of 1894. Notices appeared in the leading daily papers and journals when these eggs were again offered for sale at the auction rooms of Mr Stevens, Covent Garden, London, on 24th April 1894. As might be expected, a number of the stories put into circulation varied considerably, but the following account, which appeared in the 'Morning Advertiser' of 25th April 1894, is as accurate as any that appeared in the daily press :—

Sale of Great Auk's Eggs.—Yesterday afternoon, at 38 King Street, Covent Garden, Mr J. C. Stevens sold by auction two recently discovered eggs of the Great Auk. In submitting for sale the first of these lots, the auctioneer said the egg was one of the very finest of its type, and had been most carefully blown. It was slightly cracked, but the fracture, he remarked, was imperceptible to himself. The owner of the eggs, the auctioneer went on to say, purchased them at an auction in the south of England, together with some fossils, for the sum of 36s. Considering that he tied them in his pocket-handkerchief and rode home on his bicycle with them, it was wonderful they were not broken to pieces. The bidding started at 50 guineas, and rose by tens to 160 guineas, and from that by tens and twenties until 260 guineas was reached, at which price the egg was knocked down to Mr Herbert Massey. The auctioneer expressed great disappointment that the egg had not realised more than one sold recently by him for £300, as he considered this a far better specimen. The next lot submitted, though also a Great Auk's egg, was a specimen of an entirely different type, and almost unique in its markings. It was damaged to a somewhat greater extent than the other, but the dilapidations were not noticeable when it was lying in a cabinet. The bidding started at 30 guineas, and advanced by tens to 150, afterwards progressing by fives to 175 guineas to a private collector, who did not wish his name mentioned (see p. 260).

The most reliable account is, however, that of Mr Edward Bidwell, which appears at p. 422 of the 'Ibis,' July 1894 :—

At the disposal by auction of the contents of the Little Hermitage, near Rochester, on 14th of March last (1894), one of the lots, which was described "a collection of shells and fossils," was purchased for 36 shillings by Mr Wallace Hewett of Newington, Kent, who, previous to the sale, in looking at the fossils, had recognised an egg of the Great Auk lying amongst them.

After the auction, upon obtaining possession of his purchase, he was surprised at finding a second egg of this bird at the bottom of the box. To make assurance doubly sure, Mr Hewett took these two eggs to the Natural History Museum and submitted them to Dr Bowdler Sharpe, who confirmed his identification, and very kindly sent him on to me. From the dirty condition of the eggs, it was quite certain that they had been neglected for many years. The smaller one had a hole on one side, the edges of which were as dirty as the rest of the egg, showing it to have been an old injury. Both had recent fractures, which was hardly to be wondered at, considering the rough treatment. . . .

I regret to say that I have been unable to trace the history of these eggs previous to the sale of March 14th (1894).

In my former paper, at p. 113 of vol. ii. of these 'Transactions,' I referred to the reported story of the Dorchester or Hill Egg. Since that time I discovered that a relative of my own was acquainted with the Hill family, who now reside at Longfleet, Poole. I asked the gentleman to obtain for me all the information possible, and he sent me a long report, dated 24th August 1890, of which the following are the portions that seem to me of special interest:—

"I have twice called upon Mrs Philip Hill and Mrs Rose. Mr Philip Hill being in a dying condition, I did not interview him, as I had much of the following information from him while he was able to speak. I may here mention that Mr Philip Hill died to-day, 24th August 1890.

"I will now give you my rough notes, taken down in pencil while I questioned the two ladies above mentioned. The egg belonged to Mrs Philip Hill's grand-uncle, Mr James Way. How he came to possess it they don't know. He had to do with the Newfoundland fisheries. Beyond that they know nothing. In his will, dated 3rd day of January 1816, he is described as 'gentleman of Middlesex.' He married a Miss Watt, said to be related to Isaac Watt. The egg descended to his son, James Henry Way. The date of his death is not remembered, but a stone is erected to his memory in Kinson churchyard. Then it went to his sister, Miss Betty Stone Way, who died 25th January 1879. In 1872 Miss Betty Stone Way gave the egg to Miss Eliza Hill (eldest daughter of Mr Philip Hill), who is now Mrs Rose. At the same time she gave her two emu eggs. These got broken by accident, the Great Auk's egg escaping destruction, although it was broken when she got it.

"Miss Betty Stone Way was an old friend of Miss Eliza Hill, and, seven years before she died, said one day, 'I would like Eliza to give you something that belonged to James—he was fond of you. Go and fetch the three eggs, and I will give them to you,—he thought them valuable, or prized them.'"

It is evident that the Way family at the beginning of this century had connections with Newfoundland, for Mr Joseph Way, a brother of old James Way, states in his will that he made it prior to taking a voyage to Newfoundland.

The late Mr Philip Hill was a farmer at Pimperne, near Blandford. The Rev. Mr Walker, Curate of Pimperne (now Rector of Spettisbury), saw the egg in Mr Hill's drawing-room at Pimperne. He asked Mr Hill's son if it was a real egg. The boy went and asked his mother if it was real. The Rev. Mr Walker then told them that it was worth £100—that imitations were made and put up in drawing-rooms. Mr Hill going up to London shortly afterwards, took it to the Natural History Department of the British Museum, Kensington. He saw Dr R. Bowdler Sharpe, who informed him that it was a real egg, and wished that he could afford to buy it. Mr Hill left the egg, telling him to do the best he could with it. Next morning Mr Hill got a cheque for £50 from Lord Lilford.

The name of the Great Auk is evidently one to conjure with, if we may judge by an announcement which appeared in 'The Naturalists' Gazette,' February 1891, a trade journal printed in Birmingham. It is headed "An Oological Expedition to the Land of the Great Auk." The prospectus goes on to explain a scheme for obtaining subscriptions to be used for sending a trained oologist to the Shetland Islands, which are described as an oologist's paradise. It says, "If the season is a pretty fair one, a haul of at least 20,000 eggs (including many rare varieties) may be expected." Fortunately this plundering expedition was prevented by the efforts of Mr J. A. Harvie Brown and others.

During the last ten years comparatively little has been added to the literature upon the Great Auk, but at least two important and interesting papers deserve notice. The first came from the pen of Mr Frederic A. Lucas, osteologist, of the United States National Museum, Washington. It was published in 1890 by the Government Printing Office, Washington, from the report of the National Museum, 1887-88, pp. 493-529. It is entitled "The Expedition to Funk Island, with Observations upon the History and Anatomy of the Great Auk." The paper is illustrated with several plates, and contains a map of Funk Island, showing the landing-places, and also the part of the island at which the remains of the Great Auk are found. There are also interesting diagrams in connection with remarks on "Skeletal Variations of the Great Auk." Much information is given regarding the Bird Islands in the Gulf of St Lawrence, as well as Funk Island, off the coast of Newfoundland, and other probable breeding-places. In a note to p. 494 Mr Frederic A. Lucas refers to Apponath as a name for the Great Auk. He says, "The name Apponath, according to Carthiers, was applied by the natives to a species of bird, supposably the Great Auk, that he found in great abundance at the Island of Birds (Funk Island)." These natives were very likely the Beothucs, although, making due allowance for the twists which a word receives in being adopted into a new language, the term Apponath may have come from the Eskimo word *agpa*, an auk. The Eskimo for the Great Auk was *isarokitsok*, "he that has little wings"; for Little Auk, *agparak*. For further information on the name Apponath see 'The Great Auk: its History, Archæology, and Remains,' p. 135. Crantz's 'History of Greenland,' vol. i. p. 84, says, "*Akpa*, vulgarly called awks."

The second paper appeared in the 'Journal of Anatomy and Physiology,' vol. iii. Part I., October 1888, pp. 1-39, and is written by R. W. Schufeldt, M.D., C.M.Z.S. The paper is illustrated by five plates. It is entitled "Contributions to the Comparative Osteology of Arctic and Sub-Arctic Water-Birds." The observations upon the osteology of the Great Auk are founded upon a study of two of the skeletons that have been built up from bones collected at Funk Island by the Grampus expedition. Illustrations of the osteology of *Alca torda* Linn. are given on plates i. and ii. for comparison.

I have received from the author, Mons. M. H. Duchaussoy, a paper entitled "Le Grand Pingouin du Musée d'Histoire Naturelle d'Amiens," published in the 'Mémoires de la Société Linnéenne du Nord de la France' (tome ix., 1892-95), with plate of the Great Auk in the Museum of Natural History, Amiens. This paper gives a *résumé* of published information upon *Alca impennis* Linn., but refers in greater detail to alcine remains preserved in France.

The occurrence of two Great Auks in Waterford harbour in 1834, and the capture of one of these alive, is referred to in 'The Great Auk: its History, Archæology, and Remains,' pp. 23, 67-70. The following paragraph, which appeared in the 'Graphic,' 5th August 1893, had escaped my notice, but was sent home to me from India by one of my numerous correspondents. The article is written by Sir Robert S. Ball, LL.D., F.R.S., and gives some interesting information regarding the Great Auk captured at Waterford, besides what is mentioned by Thomson, 'Birds of Ireland,' vol. iii. p. 238.

Dr Burkitt, of Waterford, an old acquaintance of mine, and one of the best known naturalists in Ireland, has just died at an advanced age. He was principally famous as an ornithologist, and his name will be familiar to the readers of Yarrell and Thomson, and other authors who have treated of the birds of Great Britain. The career of this veteran student of nature deserves notice, if for no other reason than that he was perhaps the last surviving man of science who possessed and studied a living specimen of a remarkable bird that has since become extinct. Now that Dr Burkitt has gone, where is the naturalist who can say he has ever seen more of the Great Auk than the bones or the skins or the eggs which form our carefully treasured relics of that notable fowl? Centuries ago this penguin-like bird, as large as a goose, abounded on many coasts in northern latitudes. Fly it could not, though it could swim and dive to perfection. But, unfortunately for so defenceless a creature, the fishermen of Newfoundland discovered that roasted Great Auk was an extremely good dish. The bird was thereupon slaughtered with such waste and thoughtlessness that it became speedily exterminated. The last specimens of the Great Auk seen near the British Islands appear to have been a pair which somehow found their way into Waterford harbour in 1834. Both of them were duly captured, and one was kept alive in the possession of Dr Burkitt for some months. Fish was, of course, its natural diet, and doubtless it was supplied therewith. However, on one occasion, some vagary of appetite tempted the captive to indiscretion in the matter of potatoes, and a fatal attack of indigestion supervened. Thus lamentably perished the last Great Auk in the British Islands, if not, indeed, the very last survivor of his race the world over.[1] His skin was duly stuffed, and assigned an honoured place in Dr Burkitt's private museum. Even then a stuffed Great Auk was a valuable commodity in hard cash; and so it came to pass that his specimen was sold about the year 1850 to the Museum of Trinity College, Dublin, for £50. My father was at that time Director of the Museum, and I have a childish recollection of his delight at the acquisition of this great bird, whose characteristics he did not fail to impress upon us.

The last episode in this little history I must now mention. As the decades have slipped away, and the suspicion that the Great Auk was probably extinct became superseded by the knowledge that it certainly was so, the value of an admirable stuffed specimen increased by leaps and bounds. The authorities of Trinity College, Dublin, thus realised that their investment of £50 had now become worth, perhaps, twenty times that sum. This had a double effect. It ensured a new and handsome case, and a dignified and conspicuous position in the Museum, for this valuable remnant of a vanished race. But the authorities of the University also recognised the excellent bargain which had been made by their predecessors forty years before. In consequence thereof they becomingly conferred a Great Auk pension on the venerable savant, Dr Burkitt, which, unhappily, he did not live long to enjoy. The dismal tragedy of nature is hastening to its close. What has happened to the Great Auk is only one out of many instances in which races of striking and beautiful creatures are being, or have been, savagely exterminated by man. Can nothing be done to arrest the progress of that irretrievable desolation which threatens our globe? The prospect is inexpressibly saddening to every lover of animal forms.

It is not very easy to realise the effect upon the market for Great Auk remains if it were ever announced and authenticated that the Garefowl was not yet extinct. Every day that passes makes such an event less and less likely, but some observers of sea-bird life have not yet lost hope. Such notices as the following, which appeared in the 'Oban Times' of 11th July 1891, tend to perpetuate such hopes, although their fulfilment seems as distant as ever. I am indebted to Mr Bishopp, naturalist, Oban, for a copy of this paragraph, the part of which referring to the Great Auk is here given. The paragraph is headed "Interesting Facts about St Kilda," and in continuation says:—

Among the passengers on the homeward journey by the Hebridean s.s. were two of the islanders, Donald Ferguson, and Alexander Ferguson, his

[1] The last recorded living Great Auks were killed on Eldey, off the coast of Iceland, in June 1844. See 'The Great Auk or Garefowl: its History, Archæology, and Remains,' p. 21.

son. The latter is a very intelligent young man of nineteen years, and extremely fond of watching and taking notes of the habits of wild birds frequenting the island. He is described by Mr Thomson in his pamphlet, 'A Cruise off the Western Hebrides,' as the "*rara avis* of St Kilda." Alexander Ferguson takes a keen interest in natural history, and has made authentic notes of the arrival and departure of the various species of birds that frequent that lonely island. Strange to say, last summer many of the islanders together with Ferguson noticed a pair of birds similar in shape to the razorbill, but twice the size of that bird. They were unable to get close enough to identify those birds. The description, however, tallies with the extinct Great Auk. Can it be possible that these birds were the Great Auk? To obtain a single specimen of this species of bird would be a small fortune to any one.

In a former paper to this Society I referred to models of the Great Auk.[1] In a letter dated 6th October 1888, Dr J. E. Harting of the Linnean Society, London, and Editor of the 'Zoologist,' drew my attention to the description of a model Greak Auk which appeared in his magazine in 1880, p. 516, and which was written by Dr Harting himself. He also mentioned to me the model offered for sale at the auction rooms of Mr J. C. Stevens, 38 King Street, Covent Garden, London, 21st August 1888, lot 116, which Dr Harting says was described as follows: "A feather model of the Great Auk, constructed from observations made from genuine specimens in the possession of Viscount Hill, John Crocke, Esq." (evidently John Rocke is intended), "and Mr Foljambe respectively, and made according to Yarrell's description of the true bird." In reply to my inquiries, Mr J. C. Stevens kindly wrote me on 19th March 1897: "I find a model of the Great Auk was offered for sale 21st August 1888. The reserve price was £30, and I believe I had a bid of £20 for it. It was, as far as I can remember, a very perfect model. Another model was offered about eighteen months ago, but that I failed to get a purchaser for."

On the 19th October 1888 I called with my wife at the shop of a dealer in London who was quite a stranger to me, but who had at that time in his possession an egg of the Great Auk. I found that the dealer was not in, and that the egg I wanted to see was at another place of business of his. The manager, however, said they had another egg of

[1] 'Trans. Edin. Field Nat. and Micro. Soc.,' vol. ii. p. 118.

the Great Auk for sale, and that he would let me see it. He went into the back-shop, and soon returned with an egg in his hand which I saw at a glance was too small for that of a Great Auk, and was evidently an abnormally large egg of the razorbill (*Alca torda* Linn.) I told him he must know it was not an egg of the Great Auk, and after some hesitancy he had to admit the fact, and then closed the conversation by saying he thought I must be Mr Champley.

GREAT AUK REMAINS.

Skins.

Austria.

Prague.—Dr Anton Fritsch informs me, in a letter dated 1st March 1897, that the adult *Alca impennis* in the Bohemian National Museum was purchased by him for £5 at an auction in Carlsbad. This is the skin that was presented by the King of Denmark to Baron Feldegg (see p. 77, and App. p. 21, 'The Great Auk or Garefowl,' &c.)

British Isles.

Edinburgh Museum of Science and Art.—The splendid skin lately in the Leeds Museum on loan from Sir F. Milner was offered at public sale at the rooms of Mr J. C. Stevens, King Street, Covent Garden, on the 23rd of April 1895. The bidding started at 100 guineas, and slowly rose to 350 guineas, at which price it was bought in, as the reserve price was understood to be 360 guineas. It was almost immediately secured for the Edinburgh Museum at the price at which it had been bought in—viz., £367, 10s. It is believed to be one of the finest skins in existence, and is said to be in summer plumage. For further particulars see 'Trans. Edin. Field Nat. and Micro. Soc.,' vol. ii. pp. 107, 108.

Tring, Herts: The Museum of the Hon. W. Rothschild.—There are two skins belonging to this collection.

No. 1 (see Plate III.)—This skin, it is said, came from either Brunswick or Mainz, where it was purchased by M. Boucard of Paris and London, who sold it to Mr Leopold Field, 25 Brodrick Road, London, S.W., who offered it for £300 to the Museum of Science and Art, Edinburgh. Before sanction could be obtained from the Department at South Kensington for its purchase it was sold by the owner to Mr Rowland Ward, 166 Piccadilly, London—it was understood for £315. In a letter, dated 23rd December 1896, Mr Ward informs me that he paid 600 guineas for this skin and the Potts egg. The skin is still in the possession of Mr Ward; but the Museum at Tring will eventually be its resting-place, as it has been purchased by the Hon. W. Rothschild.[1]

I had an opportunity of examining this skin when sent to Edinburgh on approbation. It was not in very good condition, but I understand has since then been thoroughly overhauled and put in as good order as possible. It appears to me to be exceedingly interesting, for the following reasons. It is the skin of an immature bird, and probably represents the third youngest specimen of the Great Auk known. The youngest bird known is in the Museum of Natural History at Newcastle-on-Tyne. The next youngest is probably the immature specimen in the Bohemian National Museum at Prague, Austria (fig. 8, plate 59, Vogel Europa's, Dr Anton Fritsch) (see Plate II.) The next in order of age is the specimen we are now writing about. Very few immature skins seem to have been preserved by the original collectors, as there is little doubt that large skins, those of adult birds, were most valued, as being more saleable, until it was realised that the Great Auk was on the verge of extinction.

No. 2.—This skin was in the collection of Count David de Riocour at Vitry-le-François, and is referred to at p. 79 and App. p. 24, 'Great Auk or Garefowl.'

During 1887 Mr G. A. Frank, London, had some corres-

[1] This is not either of the two skins recorded, 'Great Auk or Garefowl,' p. 79, and App. p. 7, as being in the Ducal Museum of Natural History, Brunswick, for both skins are still there, as the Director, Professor Dr Wilhelm Blasius, kindly informs me in a letter dated 30th January 1897. Neither is it the skin recorded as being in the Town Zoological Museum, Mainz ('Great Auk or Garefowl,' p. 79, and App. p. 16). The Curator, Herr Wilhelm von Reichman, in answer to my inquiries, was good enough to write me from the Natural History Museum, Mainz, 15th April 1897, "We have in the Museum at Mainz a most beautiful exemplar of *Alca impennis.*"

pondence with Count David de Riocour about the purchase of his collection. He informed Mr Frank, in letters written from Vitry-le-Ville, Marne, and dated 19th, 22nd, and 27th September 1887, that he had only lately made up his mind to sell his collection if he got a suitable price. The collection contains 3000 specimens, but there is no catalogue. He says the specimens are thought very fine ones, and a considerable number served as type specimens to the naturalist Vieillot, who also partly aided in the formation of the collection. He was a friend of the family, and left by will to the grandfather of the present Count Riocour his unpublished manuscripts, which are still in the library, and are not for sale.

Among the other very rare specimens in the collection is a stuffed Great Auk. The price wanted for the collection is 40,000 francs. The collection was begun about the year 1819 by the great-grandfather of the present Count, who was aided by Vieillot, and was continued and augmented by the father of the present Count, who was a distinguished naturalist. Vieillot died about the year 1839, and his books are now said to be rare and much valued. The collection was at one time visited every year by M. Verreaux, who came to study the rarities it contained. At the foot of the stands on which the stuffed skins are mounted are said to be drawers which contain manuscript notes by different well-known naturalists regarding the specimens. The original letters are in French. Writing me on 25th October 1887, Mr G. A. Frank says, "The Count Riocour wishes to dispose of his fine collection, including one of the finest Great Auks known." This skin of the Great Auk came into the hands of M. Boucard, 225 High Holborn, London, who sold it to the Hon. W. Rothschild, who now has it in his museum at Tring.

France.

Paris.—At pp. 79 and 95 of the 'Great Auk or Garefowl,' the skin in the collection of European birds belonging to M. Jules Vian, Rue de Petits Champs 42, Paris, is referred to. I only recently obtained the address of M. Jules Vian, through the kindness of Prof. Dr W. Blasius of Brunswick. I placed myself in communication with M. Jules Vian, and on the 27th

February 1897 he wrote me in French, of which the following is a translation: "You ask me for information regarding the *Alca impennis* which I own. It is still in my almost complete collection of European birds. It is an adult in breeding plumage. I even regard it as a specimen of a bird well advanced in age, the upper mandible being marked with nine, the lower with twelve furrows. It is mounted, and has no borrowed feathers. I do not know its sex. The following information was given me fifty years ago by the stuffer of the bird. He said that it was one of a colony which laid their eggs on an inaccessible islet in the vicinity of Iceland;[1] that in 1830 a volcanic eruption covered this islet with its *débris;* that several specimens, dead or dying, were driven by the waves on the shores of Iceland, and were eaten; that he (my friend the stuffer) himself secured the subject of this letter while it was still alive. He kept it for several days on the ship which was returning to France; that it died on the way, and that he stuffed it during the voyage. In fact, its feathers, and the exact retention of its outlines and undulations, indicate a bird mounted while the skin was newly removed from the flesh" (see Plate IV.)

In answer to my inquiry for further information, M. Jules Vian, who is Honorary President of the Zoological Society of France, kindly replied on the 7th March 1897: "It was in 1847 that I saw for the first time the *Alca impennis* of which I am at present the owner. It formed part of the collection of Monsieur Oursel (father) of Havre. That collection was not very numerous, but it was composed of birds perfectly mounted, and indicated study of the forms, and especially of the heads. Accordingly, my Alca seems to me to have its head perfectly modelled after a bird that still retains its flesh. Monsieur Oursel, who had picked it up in Iceland and mounted it on the return voyage, furnished me at that time with circumstantial details, but I did not take any notes, as I did not then imagine that the bird would become part of my collection. I have nothing but recollections of fifty years ago, and my memory, which has been at

[1] This evidently refers to the Geirfuglasker, off Reykjanes, South-West Iceland, which became submerged during a volcanic eruption in 1830.—See 'Great Auk or Garefowl,' p. 20.

work now for eighty-one years, has no longer the strength of my early days.

"Monsieur Oursel (father) died a few years afterwards. I acquired the bird from Monsieur Oursel (son) in 1876, but Monsieur Oursel (son), who I believe was not born in 1830, and who had kept his father's collection without having personally any taste for natural history, was not able to give me any information. I do not know whether Monsieur Oursel (son) is still alive, but he sold all his collection in 1881.

"I did not know that some Alcæ had escaped from the volcanic eruption, and had taken refuge on Eldey. Monsieur Oursel (father) believed that they had all been destroyed.

"Some time from fifteen to eighteen years ago I had a visit from Monsieur Vouga (son), then just returned from Iceland. I had known his father Captain Vouga, and had some years previously paid a visit to his beautiful collection of birds at Cortaillod near Neuchatel (Switzerland). I had there seen a beautiful specimen of the *Alca impennis*, of which a drawing was given by his son in 1868 in vol. ii. Part I. of the 'Bulletin de la Société Ornithologique Suisse,' published at Geneva. Monsieur Vouga (son) had gone to Iceland expressly in order to try and find eggs or skeletons of the *Alca impennis* on the islet that had been covered by the volcanic eruption, but he was not able to find sailors who would consent to make a landing on the islet. It appears that this islet is the centre of a rapid current, and that it is surrounded by rocks more or less level with the surface of the water. Monsieur Vouga contented himself with ransacking kitchen-middens covered over with earth, and brought back many bones of the *Alca impennis*, but mainly the principal bones. I do not think that he managed to piece together entire skeletons.

"Some forty years ago my attention was twice attracted by the announcement of a capture of the *Alca impennis*, but when I went to verify the fact I found that in each case it was a *Colymbus glacialis*. On the sea especially, the two birds could easily be confounded by seamen who were not naturalists."

United States.

Washington: United States National Museum.—This specimen is figured at p. 533 of the Report of the United States National Museum, 1887-88, by Mr Frederic A. Lucas. In a note the writer says: "Wilhelm Schluter, of Halle, Germany, from whom this Auk was procured, gives its history as follows. It was obtained by Mr Salmin of Hamburg from Iceland; by him sold to a merchant of Hamburg, who sold it to Mr Geotz of Dresden, who in turn parted with it to Mr Schluter. In the United States National Museum catalogue of birds it is recorded as ♂ ad. Eldey June 1834.

"Since the photograph was taken from which the accompanying plate was made,[1] the specimen has been remounted in a different attitude and shortened between two and three inches. It is still like nearly all mounted skins, considerably too long, but could not be shortened any more without cutting the skin—a proceeding that, under the circumstances, was deemed inadmissible. Before remounting, a full-sized figure of the specimen was made."

Skeletons.

Australia.

New South Wales: Sydney.—A skeleton built up from bones obtained from Funk Island, Newfoundland, by the United States Grampus expedition. The authorities of the Sydney Museum of Natural History obtained this skeleton from the authorities at the United States National Museum, Washington, by exchange.—(See Report of the United States National Museum, Washington, 1887-88, by Frederic A. Lucas, p. 516. Also see 'Trans. Edin. Field Nat. and Micro. Soc.,' vol. ii. p. 109.)

British Isles.

Cambridge: The Natural History Museum. — Professor Alfred Newton kindly informs me, in a letter dated 16th

[1] This refers to the plate which accompanies Mr F. A. Lucas's Report.

March 1897, "The late Lord Lilford generously gave to our Museum the skeleton of *Alca impennis* which had been mounted from bones obtained on Funk Island by Mr Milne."[1]

The skeleton mentioned in former lists as at Lilford Hall, Oundle, must now be recorded as above.

Edinburgh.—The skeleton in the Museum of Science and Art was built up from remains found at Funk Island by the United States Grampus expedition in 1887. It was obtained by Mr Edward Gerrard, jun., of London, from the authorities at the United States National Museum, Washington, in exchange for some natural history specimens.

Germany.

Dresden.—Writing me on the 9th February 1889, Dr A. B. Meyer, Director of the Royal Zoological Museum, says: "This Museum contains, besides the skeleton of *Alca impennis* Linn. which you mention in your valuable work at p. 82, detached bones of the same, which would constitute an over-complete skeleton. These bones were bought by me, together with the bones of which I combined a skeleton, as you note at p. 100" ('The Great Auk: its History, Archæology, and Remains').

United States.

Cambridge, Mass.: Museum of Comparative Zoology.—In a letter dated 31st January 1897, Mr Frederic A. Lucas, Osteologist at the National Museum, Smithsonian Institution, Washington, informs me that one of the skeletons prepared from the collection of the United States Grampus expedition is now in the above Museum. This skeleton must not be confused with the Mummy Great Auk also in the Cambridge collection (see 'Trans. Edin. Field Nat. and Micro. Soc.,' vol. ii. p. 110). At p. 515 of the Report of the United States National Museum, Washington, 1887-88, by Mr Frederic A. Lucas, it it mentioned that this skeleton was presented to the Museum at Cambridge, Mass.

New York: American Museum of Natural History near the Central Park.—There is in this Museum a skeleton prepared

[1] Now Professor J. Milne of earthquake fame.

from the remains obtained from Funk Island by the United States Grampus expedition in 1887. I have seen this skeleton. It is mentioned on p. 515 of the Report of the United States National Museum, Washington, 1887-88, by Mr Frederic A. Lucas, that it was presented to the New York Museum.

Washington, D.C. — My friend Mr Frederic A. Lucas, Osteologist of the Smithsonian Institution, writes me on 31st January 1897, that of the material obtained by the United States Grampus expedition about twelve skeletons in all will be built up. Of this number four have already been parted with, which have gone to Cambridge (Mass.), New York, Edinburgh, and Sydney, N.S.W., so that only eight skeletons now remain at the Smithsonian Institution. Of the eight skeletons, it is mentioned at p. 516 of the Report of the United States National Museum, Washington, 1887-88, by Mr Frederic A. Lucas, that "two skeletons are retained for the reserve series of the Museum."

Detached Bones found in Ireland.

Although the Great Auk as a living bird was previously recorded from the coast of Ireland, it is only within the last few years that the bones have been discovered in the sandhills of Whitepark Bay, County Antrim. The discoverer, Mr W. J. Knowles, points out that the old surfaces of the sandhills, with their shells, broken bones, and implements, are really kitchen-middens.

Mr Knowles, in the 'Proceedings of the Royal Irish Academy' (3), vol. i., No. 5, 1891, records the finding of two humeri of the Great Auk; and again in the same 'Proceedings' (3), vol. iii., No. 4, pp. 650-663 (Dec. 1895), mentions the discovery of a number of bones in conjunction with human remains, which Mr Knowles believes to be those of the earliest Neolithic inhabitants of Ireland. Mr Knowles remarks that "from the number of bones [of the Great Auk] which have been found it must have been a common inhabitant of the north of Ireland at the time when the people of the Stone Age occupied Whitepark Bay and other parts of the coast."

The foregoing information appeared in the 'Irish Naturalist' for May 1896, in a paper written by Mr G. E. H. Barrett

Hamilton, B.A., and I am indebted to Professor Alfred Newton of Cambridge for kindly sending me his copy of this paper to take my notes from.

Having read in the notice in the 'Irish Naturalist' that the bones of *Alca impennis* had been identified by Mr E. T. Newton of the Geological Survey, I wrote that gentleman asking him to oblige me with further information. He kindly replied from the Geological Survey Office, London, on 26th March 1897, saying: "The bones of the Great Auk which I saw were the humeri, but as to the numbers that were found I have no information." Mr Newton, however, kindly sent me the address of the discoverer of the bones, Mr W. J. Knowles, Flixton Place, Ballymena. In reply to my inquiries, that gentleman wrote me on 29th March 1897: "I only found remains of *Alca impennis* at Whitepark Bay, County Antrim. The bones, as far as they have been identified, are humeri. I may have others of different parts of the bird, and not know them. I have found bones, I should say, of ten or more individual Auks."

Writing me again on 5th April 1897, Mr Knowles says: "I have counted the bones which are now in my possession, and I find I have two right and two left humeri that are perfect and the upper half of a right humerus. I have also a shaft without either end, which I believe belongs to the same bird. I gave either two or three bones to the Royal Irish Academy, but whether they were right or left I cannot tell, as I took no note. When I sent a second lot of bones to Mr Newton for identification, he asked me for a specimen, which I gave him. I have his notes before me, and I find that he retained a right humerus. The bones I have are exactly like those figured by you in one of the papers you sent me, both as regards marks and size. As for the number of birds those bones would represent—say three to the R.I.A., one to Mr Newton, and five or six in my own possession—we would have at least five individuals, but more likely seven or eight, or more, as, except in one instance where I found two humeri near each other, and I don't remember whether they were right or left, the others were all found apart. I have still some bones that have not been professionally examined, and I may find other bones than humeri among them.

"Whitepark Bay is on the north coast of Antrim, lying about midway between Ballycastle and the Giant's Causeway."

Bones.

British Isles.

Ballymena.—In the collection of Mr W. J. Knowles, Flixton Place, Ballymena, there are bones representing at least five or six individual birds (see p. 256).

Dublin.—In the Natural History Museum of the Royal Irish Academy there are bones representing probably three specimens (see p. 256). In answer to my inquiry by letter, the Secretary of the Royal Irish Academy, writing on 22nd April 1897, says: "The curatorship of the Academy's Museum is vacant, and pending the appointment of a successor to the late curator I have not been able to get particulars of the objects from Whitepark Bay."

Leeds: Museum of the Philosophical and Literary Society.—Writing me on 22nd November 1887, Mr Wm. Eagle Clarke, then of Leeds, now of Edinburgh, says: "We have some of the Funk Island remains in this Museum. They were purchased of Gerrard, the dealer."

London.—A right humerus was presented to Mr E. T. Newton by Mr W. J. Knowles, Ballymena, and is now in the possession of Mr Newton, who writes me from the Geological Survey Office, 28 Jermyn Street, London, S.W., 7th April 1897 (see p. 256).

London.—Skull and several bones in the possession of Mr Rowland Ward, F.Z.S., 166 Piccadilly, London, W., in litt. dated 23rd December 1896. In another letter, dated 22nd March 1897, Mr Ward informs me that "the bones in question came from Funk Island, and were bought at Stevens' Auction Rooms."

Tring, Herts.—In the museum of the Hon. W. Rothschild there are some bones taken from a stuffed bird purchased from Shaw of Shrewsbury. Mr Rowland Ward, F.Z.S., in litt. 19th March 1897.

United States.

Cincinnati.—"Some bones have gone to the Cincinnati Society of Natural History" (Mr Frederic A. Lucas, in litt. 31st January 1897). These bones formed part of the collection made at Funk Island by the United States Grampus expedition in 1887.

New York: Central Park Natural History Museum.—There are a number of bones of *Alca impennis* Linn. preserved in a box in this museum. These bones are part of the collection made by the United States Grampus expedition to Funk Island in 1887. I got this information when I visited this museum in May 1889.

EGGS.

British Isles.

Bristol: Ashton Court.—The egg which belonged to Mrs Wise,[1] and which was sold at Stevens' Auction Rooms, London, on 12th March 1888, and bought by a dealer in natural history specimens, Oxford Street, London, for £225, is said to have been sold to Sir Greville Smyth, Ashton Court, for £315.

Calke Abbey, Derbyshire.—This egg belonged to the collection of Mr Yarrell, who purchased it in either Paris or Boulogne for two francs. There are two versions of how he became possessed of it. The one is that related by the late Mr. R. Champley from information given him by the late Mr Frederick Bond, and which appears at p. 105, 'The Great Auk: its History, Archæology, and Remains'; and the other is that by Professor A. Newton of Cambridge, who, writing to 'Nature' in August 1894, gives what is described as the "true" account. He says: "It was found hanging on a string with a number of other eggs in a curiosity-shop of mean appearance in Paris. On asking its price, Mr Yarrell was told it was two francs, on account of its size. The money was paid." After Mr Yarrell's decease it was purchased in Mr Stevens' Rooms in 1856 by the late Mr James Gardiner for the late Mr Frederick

[1] 'Trans. Edin. Field Nat. and Micro. Soc.,' vol. ii. p. 114. See also *ante*, p. 237.

Bond at £21; and by him it was sold to Baron d'Hamonville, Manonville, Meurthe-et-Moselle, who offered it for sale at Stevens' Rooms, London, 22nd February 1894, lot 112. The following account of the sale is from the 'Standard,' 23rd February 1894:—

It [the egg] is not quite perfect, but is beautifully marked. Mr Stevens started the lot by bidding 100 guineas. The next bid was 110 guineas, and by tens 200 guineas was rapidly reached. There was a pause, but Mr Stevens, with a little coaxing, and saying that he hoped to obtain 300 guineas at least, when he should be happy, started the bidding again at 210 guineas. Another pause was followed by Mr Stevens informing the company that there was no reserve, and that when the egg had been sold any desiring purchaser would lose all chances of obtaining it. Then came a bid of 220 guineas, followed by others of 240, 250, 260, 270, and 280. Mr Stevens (to a gentleman in the middle of the room), "Surely you will not let it stop at this price! Are you quite sure you have made up your mind?" Another bid of 290 guineas was the result, amidst cheers, and then Mr Stevens pathetically appealed to his audience to go as far as 300 guineas. A gentleman who stood near to him raised his pencil, and the figure was secured. Then came the formal announcement of 300 guineas once, twice, and the third and last time, and the hammer fell to the agent of Sir V. H. Crewe. Mr Stevens afterwards informed a reporter that the sum realised was the largest one for any Auk's egg that had as yet been under the hammer.

This egg is now in the collection of Sir Vauncey H. Crewe at Calke Abbey, Derbyshire. A writer in the 'Daily News,' 23rd February 1894, mentions that it is figured in Hewitson's 'British Oology.' A rough figure of it also appeared in 'The Sketch' of 7th March 1894.

Cambridge: Natural History Museum.—The following correspondence explains itself. On 8th October 1888, the late Lord Lilford wrote me: "I have not transferred my collection of eggs to the Cambridge Museum, but some time ago presented *four* of the five eggs of Garefowl in my possession to Professor Alfred Newton. These were the two Edinburgh eggs, that which you refer to from Lausanne, and the Dorset specimen. I retain the egg purchased from my sister, with the stuffed Garefowl, after the death of her husband, Arthur Crichton. I distinctly wish to repudiate any claim to the gratitude of the Cambridge Museum, which is the sole and just due of Professor Alfred Newton in this matter."

Writing me on 16th March 1897, Professor Alfred Newton says: "The late Lord Lilford generously gave me four of the five eggs he possessed. These, with his full approval, I at once transferred to our Museum."

Croydon, Surrey.—A mistake regarding the history of this egg appears at p. 114, vol. ii., 'Trans. Edin. Field Nat. and Micro. Soc.' Mr Edward Bidwell informs me, in a letter dated 11th May 1897—"Canon Tristram's collection, containing the Great Auk's egg, was purchased by Mr Philip Crowley, F.Z.S., of Waddon House, Croydon, and not by his brother, the late Mr Alfred Crowley."

Didsbury, near Manchester.—There are two eggs in the collection of Mr H. Massey at Didsbury—1*st*, The egg which belonged to the Rev. Henry Burney (see 'The Great Auk or Garefowl,' &c., pp. 88 and 106, also App., p. 34). This egg was sold by auction at the rooms of Mr J. C. Stevens, King Street, Covent Garden, London, on 12th December 1887, to Mr Leopold Field, for £168. This egg has now changed hands privately, and is in the collection at Didsbury. I am informed that it was sold by Mr Field through Marsden to Mr Massey for £220—see litt., 25th March 1897. 2*nd*, One of the Rochester eggs was bought by Mr Massey at Stevens' auction sale (see *ante*, p. 241). This egg is a very beautiful specimen; it measures $4\frac{11}{20} \times 2\frac{17}{20}$ inches. It was purchased by Mr Massey for 260 guineas. It has a creamy-white shell of fine texture, streaked and blotched, especially at the smaller end, with rich red brown.

London.—The egg which was in the collection of Mr J. Hack Tuke at Hitchin, Hertfordshire, was lent to the Saffron Walden Museum. The curator, Mr Maynard, is said to have made some casts of it. This egg, which measures $4{\cdot}753 \times 2{\cdot}951$ inches, was, I am informed, once more in Mr Tuke's private collection at Hitchin, and on his death was sold by his executors at the auction rooms of Mr J. C. Stevens, Covent Garden, London, on 20th April 1896. It was purchased by a Mr Noble for Mr W. Newall, 27 Hans Place, London, S.W., who now has it in his private collection (see litt. from Mr Newall, 22d December 1896).

London.—Mr Henry Munt, who bought one of the Rochester eggs (see *ante*, p. 241). It is now in his collection at 83 Kensington Garden Square, W. Mr Edward Bidwell, in a paper in the 'Ibis,' July 1894, p. 243, says: "This egg measures $4\frac{6}{20} \times 2\frac{14}{20}$ inches, has a very rough texture, the markings being chiefly shell-spots. It was purchased by Mr Henry Munt for 175 guineas."

London.—Three eggs, collection of Mr T. G. Middlebrook, "Edinburgh Castle," 57 Mornington Road, N.W.

No. 1.—This egg was bought from Perrot, a dealer in Paris, on 23rd November 1847, for 200 francs (about £8, 3s. 4d.), by the late Sir William Milner, Bart. of Nunappleton, Yorkshire ('Great Auk or Garefowl,' p. 104). It was sold for his successor, Sir F. Milner, Bart., M.P., at the auction rooms of Mr J. C. Stevens, 38 King Street, Covent Garden, London, W.C., on 23rd April 1895, lot 261, for 180 guineas, at which price it was bought by Mr T. G. Middlebrook.

No. 2.—The egg that was in the collection of the late Mr T. H. Potts, who died very suddenly in 1888, was seen by me at the house of his widow at Christchurch, New Zealand, who told me she was anxious to dispose of it. It was some years afterwards, about the beginning of 1891, purchased by Mr Henry O. Forbes, then curator of the Canterbury Museum, Christchurch, N.Z., it was said for a friend in England.[1] This is perhaps the only egg of *Alca impennis* that has ever been in the Southern Hemisphere, and it has now found its way back to England. It was in the collection of Mr Leopold Field, 25 Brodrick Road, London, S.W. He sold it to Mr Rowland Ward, F.Z.S., 166 Piccadilly, London, W. (see litt., 4th January 1897).

I was shown this egg by Mrs Potts on 13th March 1889, and I find the following note in my diary: "It is covered with small blotches, and finely marked with thick pencillings at the large end. It has a large amount of white on the body and a very little dark shading. Several of the marks are almost lost in the shell, as if they had been absorbed by the calcareous matter before the egg was laid, but they show quite clearly. It is an average-sized egg, in a very good state of preservation, and has been end-blown. The holes at each end

[1] 'New Zealand Herald,' monthly summary, 24th April 1891; also p. 89, and App., p. 31, 'The Great Auk or Garefowl: its History, Archæology, and Remains.'

are small and perfect, and show very little. There were no fractures to be seen."

This egg was sold at the rooms of Mr J. C. Stevens, 38 King Street, Covent Garden, London, on 13th April 1897, at 2.30 P.M., and is described on p. 13 of the catalogue as "Lot A, Egg of the Great Auk, a very fine and perfect specimen." Referring to this sale, the 'Standard' of 14th April 1897 says:—

> A considerable amount of interest attached to the sale by auction yesterday, at Mr J. C. Stevens' Rooms in King Street, Covent Garden, of a very fine and perfect specimen of an egg of the Great Auk. There was a very large attendance, and, after a spirited competition, the bidding, starting at 100 guineas, quickly rose by 5 and 10 guinea bids, until the sum of 280 guineas was reached, at which price the much-sought-after specimen was knocked down to Mr T. G. Middlebrook.

No. 3.—Messrs Jay of the Mourning Warehouse, Regent Street, London, purchased an egg of *Alca impennis* Linn. for £173, 5s. at public sale at Mr J. C. Stevens', 38 King Street, Covent Garden, London, on 25th June 1895, lot 211. This egg was taken, the sale catalogue says, in Iceland, about 1830, by a shipowner of St Malo, who bequeathed it to the Comte Raoul de Beracé, whose collection was purchased by the Baron d'Hamonville. This specimen, slightly cracked, which in colouring and texture is unique, was figured in the 'Mémoires de la Société Zoologique de France' in 1888, plate 6, fig. c; and additional notes on its history appeared in the 'Bulletin' of the Société in 1891 (see also pp. 88, 104, and 105, 'The Great Auk: its History, Archæology, and Remains'; also 'Zoologist' for 1895, p. 269). The egg was in the possession of the International Fur Store (Jays, Limited), 1st January 1897 (see letter from them).

On the 27th July 1897 this egg was again offered for sale at the Rooms of Mr J. C. Stevens. The 'Daily Telegraph' of 28th July 1897 says: "Dealers and private collectors were present in large numbers, but the bidding, which was commenced at 100 guineas by Mr Middlebrook, was very slow. This sum was advanced, after a long pause, to 120 guineas, when again there was a halt, no one apparently thinking the cracked egg worth more. Three advances of 10 guineas were made, then another of five. Mr Middlebrook added a further five, making a total of 160 guineas, at which figure he became the purchaser."

Scarborough.—The collection of the late Mr R. Champley is still at the same address, 13 The Crescent, Scarborough, where it is in the possession of his daughter, Miss Blanche E. Champley.

Stratford-on-Avon: Ettington Park, Mr S. E. Shirley.—This egg is said to have been formerly in a large collection of natural history specimens belonging to a Mr Shepherd of Bristol, and, having been labelled as the egg of a penguin, remained unnoticed for some eighty years. Writing me on 18th December 1896, Mr S. E. Shirley, says: "My egg has been here many years, and is believed to have formed part of a large collection of birds, eggs, heads, feet, &c., bought by my grandfather early this century, but the catalogue of the collection marked 'Catalogue of the Collection 6 of W. Shepherd, Bristol, 1807,' does not include the Great Auk egg; but it is badly done, and other eggs are also omitted. The egg is a very fine one, boldly and richly marked, and of good size, quite perfect, with the exception that it is blown with a rather large hole. I fear this is all I can tell you about it. It was originally in a small cardboard case with a glass lid, and was stuck to the back of the case in quite the primitive style of egg-collectors."

Tring, Herts: Museum of the Hon. W. Rothschild.—The egg in this collection was bought about March 1889 with the collection of Count Rodern at Breslau. For further particulars see 'The Great Auk: its History, Archæology, and Remains,' pp. 89, 108, and App., p. 25.

United States.

Washington.—The egg No. 15,141 in the United States National Museum, Smithsonian Institution, is figured in the Report of the National Museum for 1888, Plate LXXIII. The following note, from the pen of Mr Frederic A. Lucas, appears opposite the plate:—

The specimen measures 125 m.m. by 74 m.m. This egg was obtained from the Academy of Natural Sciences, Philadelphia, Pa., and was originally in the collection of O. des Murs. It is the egg figured on

Plate I., 'Revue et Magazin de Zoologie,' 1863, and the one to which des Murs refers in the text as having been broken and restored. That des Murs had three eggs of the Great Auk is extremely improbable, as he states that he never even saw more than the two in his possession, and the reference to three is either a slip of the pen or of memory. The egg seems to have been washed since it was figured, and the freshness of the markings thereby impaired.

The foregoing statement seems to dispose of the story that des Murs had at one time three eggs of *Alca impennis* Linn. in his possession (see also 'The Great Auk or Garefowl,' &c., p. 89, and App., pp. 32 and 34).

SUMMARY OF EXISTING REMAINS OF THE GREAT AUK OR GAREFOWL (*Alca impennis* Linn.)

Number of birds represented by the following remains :—

Skins	79 or 80
Skeletons (more or less complete) .	23 or 24
Detached bones . . .	850 or 861
Physiological preparations . .	2 or 3
Eggs	70 or 72

PRINTS FROM PHOTOGRAPHS.

The photographs from which the illustrations have been prepared were obtained as follows, and I desire to acknowledge my obligation to those kind friends for supplying me with these photographs, as otherwise it would have been out of my power to give the illustrations :—

Plate I. This interesting photograph is the work of Mr Joseph Jobling, photographer, 1 Shakespeare Street, Newcastle-on-Tyne, who has copies for sale.

Plate II. This is also a very interesting photograph, and has been sent me by Dr Anton Fritsch, of the Natural History Museum, Prague, to whom I tender my best thanks.

Plate III. This photograph is of a most interesting specimen. The copyright is the property of Mr Rowland Ward, F.Z.S., 166 Piccadilly, London, W., to whom I have to acknowledge my obligations.

Plate IV. This photograph is of a little-known but very fine adult specimen of the Great Auk to which I refer at p. 250. I am indebted to M. Jules Vian, Honorary President of the Zoological Society of France, Rue des Petits Champs 42, Paris, its owner, for kindly sending me the photograph.

Plate V. This is also the work of Mr Joseph Jobling, photographer, 1 Shakespeare Street, Newcastle-on-Tyne, who owns the copyright and has copies for sale.

Description of Figures of the Great Auk (*Alca impennis* Linn.) Reproductions from Photographs given herewith.

(*These photographs are copyright.*)

Plate I. Young specimen preserved in the Natural History Museum, Newcastle-upon-Tyne (see p. 267).

Plate II. Young specimen preserved in the Natural History Museum, Prague (see p. 268).

Plate III. Immature specimen acquired by the Hon. W. Rothschild from Messrs Rowland Ward, Ld., London, for his Museum at Tring, Herts (see pp. 249 and 269).

Plate IV. The specimen in the collection of M. Jules Vian, Honorary President of the Zoological Society of France, Rue des Petits Champs 42, Paris (see pp. 250 and 270).

Plate V. Adult specimen in the Natural History Museum, Newcastle-upon-Tyne (see p. 271).

COMPARISON—PLATES I., II., AND III.

Plate I. This is a reproduction from a photograph of the youngest specimen of the Great Auk (*Alca impennis* Linn.) that is known. This appears to be the general opinion of naturalists. It is, however, very remarkable that the white mark on the plumage of the side of the head in front of the eye, which appears in all adult specimens, is also appearing on this young bird, while on that in Plate II., which is generally assumed to be a Great Auk, and the older bird of the two, the white mark is absent. The remainder of the plumage of the Plate II. specimen, however, gives one the impression that it is the older, as there is a more clearly defined line between the dark plumage of the back and the light plumage of the front of the body. The plumage of the back is also less speckled than in the No. 1 specimen, and has a closer approach to the plumage on the back of the adult bird. The breast of the bird figured on Plate I. is spotted and mottled; that on Plate II. is more spotted and less mottled than Plate I. The specimen on Plate III. is probably the third youngest specimen known, and has still some spotted plumage about its head and the front of its neck. The small size and general appearance of this specimen lead one to infer that it is immature. It is exceedingly interesting, and it is unfortunate that we know so little about its history.

YOUNG SPECIMEN

Preserved in Natural History Museum, Newcastle-upon-Tyne.

Plate I. Newcastle-upon-Tyne.—Young Bird.[1]

This specimen is worth studying, and is believed to be the youngest specimen of *Alca impennis* Linn. known. It was stuffed by that skilled taxidermist the late Mr John Hancock. He has chosen for it an attitude of vigilant watchfulness, such as a sea-bird assumes upon a rock or cliff when it hears some unusual sound or suspects the approach of danger.

The plumage upon the upper part of the neck and back is mottled, the dark colour predominating. The white spot in front of the eye is quite visible, and it shows as a mottled patch, as if the ground had been dark-coloured but the incoming white plumage was gradually replacing what had been dark.

There are fewer furrows upon the mandibles of this specimen than on any other known, which all points to its being the youngest recorded.

Upper mandible, two furrows posterior end; and
Under mandible, three furrows about middle.

[1] For comparison see note on the Prague young bird; also *ante*, p. 265.

Plate II. Prague Specimen (Young).[1]

This picture shows the bird in a natural position. It has no white spots in front of its eyes, and no sign of any such spot is shown on the photograph.

Its upper and lower mandibles both have furrows—upper four distinct, and two obscure furrows; lower seven distinct furrows.

The white plumage on this specimen extends up the breast half-way up the throat, and then upwards as a speckled surface as far as to reach the upper portion of the posterior part of the lower mandible. Where the white plumage approaches the dark upon the throat and upper part of the breast, the dark and white plumage intermingles, which gives the plumage a speckled appearance. There is an extension of the dark plumage on to the white, beginning just below the wing. There is a good big patch of oblong shape.

This figure of the bird might almost lead one to suppose it was some other species than *Alca impennis,* but assuming it to be correctly named when compared with the Newcastle-upon-Tyne young bird, one would judge as follows:—

1*st,* From the absence of the white marks in front of the eyes that it was a younger specimen, as the Newcastle-upon-Tyne specimen shows clearly the marks in front of the eyes, and the dark plumage upon this spot disappearing.

2*nd,* From the furrows upon the mandibles this would be judged to be the older bird, as there are fewer furrows on the upper and under mandibles of the Newcastle-upon-Tyne bird.

3*rd,* The plumage of these two specimens upon the heads and breasts is so different that they might be taken as belonging to distinct varieties. The general appearance of the plumage of the Prague specimen would lead one to conclude it was the older bird of the two.

4*th,* The Prague specimen has been rather over-stuffed, and would approach closer to the natural bird if the taxidermist had prepared it a little more attenuated in form. It is a most interesting specimen, and I desire to express my indebtedness to Dr Anton Fritsch, of the Natural History Museum, Prague, for so kindly supplying me with a photograph for this paper.

[1] There is also an adult specimen of *Alca impennis* Linn. in the Prague Museum.

PLATE II.

YOUNG SPECIMEN

Preserved in Natural History Museum, Prague.

IMMATURE SPECIMEN

In Collection of Hon. W. Rothschild.

PLATE III. BOUCARD-FIELD SPECIMEN OF THE GREAT AUK.

Photograph received 25th March 1897 from Mr Rowland Ward, 166 Piccadilly, London, W.

The photograph shows some slight traces of speckles upon the dark plumage of the neck and breast.

The upper mandible has three furrows distinct and two obscure.

The under mandible has nine furrows distinct and one obscure.

The bird is smaller in size than any adult specimen I know of.

The white spot upon its head in front of the eye is clearly defined.

There is a dark shade upon the white plumage on the body lower than the wing, as if it were a trace of the same dark patch of plumage shown in the young Prague specimen, which is an extension of the dark plumage on the same part of its body on to the white plumage.

The bird is stuffed in what seems to me a natural position.

Plate IV. Vian Specimen.

This specimen is referred to at p. 250, and is an adult bird. Its owner, M. Jules Vian, is fully aware of what he describes as the "irregularities of its pose." It is a very beautiful specimen, and needs no apology for its attitude, which may be a natural one, although unusual. I think we may assume that the taxidermist intended to represent the bird as about to flap its wings.

PLATE IV.

SPECIMEN

In Collection of M. Jules Vian.

ADULT SPECIMEN

In Natural History Museum, Newcastle-upon-Tyne.

PLATE V. THE NEWCASTLE SPECIMEN.—ADULT BIRD.

This is an adult bird, stuffed by the late Mr John Hancock, who has placed the bird sitting with its egg between its legs in an attitude of alarm, such as a sea-bird assumes when sitting upon its egg when it observes some one approaching. I have often observed *Alca torda* Linn. and Uria, when they hear a strange sound, assume the position of the young bird of vigilant attention (see Plate I.); then the moment they caught sight of the cause of the noise, crouching down and drawing in their necks if they apprehended danger, just as this adult specimen is depicted doing, as if trying to conceal themselves.

In Memoriam.

Since this paper was prepared for publication the writer has received the sad intelligence of the death of "The Father of Garefowl History," Professor J. JAPETUS S. STEENSTRUP, Doctor of Philosophy and Medicine, and Professor of Zoology in the Royal University, Copenhagen. This great zoolgoist was born at Vang, in Norway, on 8th March 1813, and died at Copenhagen on 20th June 1897, at the ripe age of 84. His name will probably be best known to future generations for his wonderful discoveries in connection with hermaphroditism in nature, alternation of generations, &c.

As a correspondent he was kind and generous to a degree, affording information and writing long letters, with quotations and references which must have required careful study. In failing health correspondence of this kind was written, and as the recipient of such letters I pay my tribute of respect to his memory by placing his portrait at the commencement of this paper, with the consent of his family.

Professor Steenstrup's great attainments as a scientist did not go unrewarded, as he was made a Danish Counsellor of State, and was decorated with the Grand Cross of the Order of Daneborg and the Silver Cross of the same Order, and also received decorations from a number of foreign Governments, and was elected a member of many learned societies.

Among the naturalists whose names are closely associated with the Great Auk, the following have died since the beginning of this decade:—

Mr JOHN HANCOCK, of Newcastle-upon-Tyne, who was well known as a naturalist and taxidermist. The museum at Newcastle-upon-Tyne is indebted to him for his splendid donations of specimens. He was born in 1806, and died 11th October 1890, aged 84.

Alderman R. CHAMPLEY, who was twice Mayor of Scarborough, died suddenly on 29th January 1895, aged 65. He possessed the most extensive collection of Great Auk eggs in the world, and these still remain in the hands of his daughter. He was a kind correspondent, and at all times enthusiastic about everything appertaining to the Great Auk. At one

PROFESSOR J. JAPETUS S. STEENSTRUP.

Born 8th March 1813: died 20th June 1897.

(See p. 272.)

time he made lengthened journeys upon the Continent, inquiring about, and purchasing, alcine remains. He also wrote several papers upon the same subject.

The late Lord LILFORD was fourth Baron, and was born in 1833, and died 17th June 1896. He was an enthusiastic naturalist, amongst his writings being the 'Coloured Figures of the Birds of the British Isles,' and his last, and perhaps most important work, the 'Birds of Northamptonshire.' He made a fine collection of Great Auk remains, the major part of which is now in the Cambridge Museum.

[All changes that have taken place in regard to alcine remains, so far as noticed by me to 31st July 1897, are mentioned in the above paper.—S. G.]

At this meeting Dr Sprague read a Note "On the Occurrence of the Fresh-water Mussel (*Anodonta cygnea*) in Dunsappie Loch."

IX.—*THE KEA, OR NEW ZEALAND PARROT.*

BY MR TOM SPEEDY.

(*Read April 28, 1897.*)

WHEN a paper is read to this Society, it is generally with the view of imparting information to its members. The present one, however, may be regarded as an exception, as I am ignorant of the habits of the bird it refers to except by information at second hand. My object in submitting the paper to you at all is to acquire knowledge from those of you who may have been in New Zealand and have seen the bird in its native habitat. I have written to a friend who has charge of a large pastoral district in that country to secure for me a young kea, which I hope to keep as a pet, and at some future date exhibit at a meeting of this Society. I have been told that these birds make interesting though mischievous pets.

My curiosity was first aroused in regard to this bird last year, when calling for Mr Davidson, the manager of the New Zealand Land Company in this city, and from whom I heard of the destructive habits of the bird among the sheep stock in the island. It was at Mr Davidson's request that I undertook the task, a few years ago, of collecting and transporting stoats and weasels to New Zealand in order to cope with the rabbit pest there.

Like the heron and short-eared owl in this country, the kea (*Nestor notabilis*) appears to hunt for its prey either by day or by night. Before the advent of sheep to New Zealand it fed on insects, larvæ, seeds of alpine plants, berries, &c. It was, I am informed, extremely interesting to watch its habits, using its bill like a pick-axe when unearthing its food. It has an ungainly hopping waddle when on the ground, but it is exceedingly dexterous among branches, and, like other parrots, uses its bill to assist locomotion. It has no enemies but man, and, like many birds in this country, its life is a happy one so long as the weather continues fine and natural food is abundant. When, however, a severe winter sets in, accompanied by a heavy fall of snow, this bird of the mountains descends to the plains, and even there, like most of the feathered tribe, it has a difficulty in procuring its food-supplies. This is now aggravated by the sheep-graziers burning the old pasturage in order that it may spring afresh, thus destroying the larvæ of insects, and many of those shrubs which require some years' growth before they again produce berries, and which necessarily limits the food-supplies of the kea.

During the mice plague on the Border pasture-lands, rooks in that district became exclusively carnivorous, and preyed upon the rodents. In like manner the kea adapts itself to the exigencies of its circumstances, and becomes carnivorous, preying upon animals of no less importance than sheep. A popular idea prevails that in an exceptionally hard winter a kea, in its struggle to obtain a scanty subsistence, had been attracted to the slaughter-house of a farmyard. Noticing sheep-skins hanging about, it had begun to pick bits of fat which adhered to them, as is the habit of tits and other small birds in this country. Finding this food congenial to its taste, it next attacked the carcasses hanging to cool in the station, picking right through the loins in order to reach the kidney fat. It must have regarded this as a delicacy, as it subsequently attacked the living sheep. While this theory is a plausible one, I do not by any means vouch for its accuracy; but the fact remains that the bird in question became, like the rabbit, a serious pest to New Zealand farmers. Like vultures round the Towers of Silence in India, the kea hung about the stations, feeding upon the offal. Their education quickly progressed, for, as already mentioned, they soon attacked the living sheep for the purpose of tearing out the kidney fat. To such an extent did their depredations increase, that instances are recorded of stock-holders being ruined, and having to leave their farms in consequence—as many as a thousand sheep having been destroyed on a small area in one year, while scores were sometimes killed in a single night. I am inclined to accept this statement, however, with the proverbial pinch of salt.

The kea's mode of attack is to single out a sheep, and to chase and harass it, as I have seen an eagle do with deer, till it is exhausted. Then with its pick-axe beak it tears a hideous wound through the loins till its ghastly work is completed.

As in the case of the rabbit-plague, the depredations of this bird attracted the attention of the New Zealand Government, and a price was put upon its head, by which means they were speedily reduced in numbers. Even yet, however, farmers reward their shepherds for destroying them.

The first announcement of this strange development of character in the kea was made in the 'Otago Daily Times' newspaper in the following terms. After referring to the new disease among sheep, there being always found a patch of raw flesh on the loin, it goes on to say:—

> At last a shepherd noticed a mountain parrot sticking to a sheep, and pecking at a sore, and the animal seemed unable to get rid of its tormentor. A watch was kept on the birds, with the result that a number were observed surrounding a sheep, alighting on its back in turns, tearing out the wool, and making the sheep bleed till it ran from the rest of the flock, when they pursued it till exhausted. This is generally practised at an altitude of from 4000 to 5000 feet, and only in winter.

In another newspaper of the colony it is stated that a foal was attacked, and would have been killed had it not been rescued. In another instance two hundred out of five hundred choice sheep were destroyed.

This is a remarkable change of habits under altered conditions—for of course it has only come about since sheep were introduced into the districts the kea inhabits, as there were no indigenous animals for it to prey upon.

X.—*THE UPPER ELF LOCH, BRAIDS.*

[First Paper.]

By Messrs THOMAS SCOTT, F.L.S., and JOHN LINDSAY.

(*Read April 28, 1897.*)

On 21st March of last year (1896) one of the writers of this paper (Mr T. Scott) paid a visit to a small sheet of water on the south side of the Braid Hills for the purpose of learning what forms of the Entomostraca were to be found there. It was then observed that this little loch contained Volvox globator in abundance, the oöspores at that early date, owing to the mild weather, having germinated and risen to the surface. This was a most interesting discovery, seeing this motile alga, so much prized by microscopists for its graceful form and curious life-history, had only once been previously recorded for the Edinburgh district. As it was believed that this sheet of water would yield many other forms of life specially interesting to the microscopist, the present joint investigations were determined on; and the division of labour in regard to these may here be noted. The dredgings were either made by Mr Scott or under his directions; and, while taking a general supervision of the material collected, Mr Scott devoted his attention more particularly to the groups of the Entomostraca and the Mollusca, the reports on these being drawn up by him. To the other member fell the duty of noting such groups as the various kinds of Algæ, the Infusoria, the Rotifera, &c. As the working up of these groups required both time and labour, besides an intimate acquaintance with them, the help of specialists was sought, as will afterwards be more particularly stated. To the second member has also fallen the task of gathering together the varied information thus acquired, and presenting it in the form of a report. Our aim has been more especially to endeavour to discover the minuter forms of life present in this loch, for the benefit of workers with the microscope; but other representatives of its flora and fauna have also been observed and noted. This paper is meant to be somewhat of a preliminary one, as it has been determined to carry on these investigations for another year, seeing the results already attained have been both satisfactory and encouraging.

The sheet of water now under consideration is situated, as already said, at the southern extremity of the Braid Hills, nearly 700 feet above sea-level. It seems to depend for its water-supply solely on rains and surface-drainage, and under these comparatively stagnant conditions some forms of life are abundant, while others are rare or entirely absent. Its eastern end is on the estate of Mortonhall, and consequently private—a wall on each side, with a connecting barbed-wire fence between, separating that portion from the larger and public part. On applying to D. F. Mackenzie, Esq., the factor for the Mortonhall Estate, that gentleman very kindly granted us permission to carry on our investigations at this private part also, as well as at another loch adjoining, on the same estate. The present paper, however, refers wholly to the first-mentioned loch, partly public and partly private, as just stated. It was believed by us at first, from an examination of the Ordnance Survey map, that the name of this sheet of water was the Elf Loch. But on Mr William Evans learning that these investigations were being carried on by us, he wrote to say that he knew the ground well, having lived when a boy at the adjoining farm of Buckstane, and that he had always understood the Elf Loch to be the second sheet of water already mentioned, situated at a much lower level, and near the Mortonhall avenue. Mr Mackenzie, on being appealed to, very obligingly consulted some old plans of the estate, and wrote to say that Mr Evans was correct in his belief that the sheet of water within the Mortonhall grounds was the true Elf Loch, and that the pond we were working at, though marked on these old plans, was without a name. The city arabs who frequent the hill know the latter loch as the "Dead Man's Pond," but this designation was rejected by us, for obvious reasons. Still, it was almost a necessity to have some name for the loch we were investigating. On meeting Mr Mackenzie one day at the Braids, he kindly went over the ground with us, when he pointed out that there was a close connection between the two lochs, as when the water in the upper loch rose to an abnormal height, and overflowed the surrounding ground, the surplus water found its way through a rocky eminence separating it from the lower loch, or Elf Loch proper. That the surplus water from the upper loch was really got rid of in this way had been proved, we were informed, by a strong aniline dye having been put into its overflow, enabling it thus to be identified as it emerged from the other side of the intervening hill and fell into the lower loch. On account of this phenomenon, therefore, we have ventured, for the purposes of this paper, to name the one the Upper Elf Loch and the other the Lower Elf Loch. As already stated, however, the present investigations refer wholly to the upper sheet of water.

We have been unable to learn anything regarding the origin or the history of the Upper Elf Loch. That it would at one time cover a much larger area than it does at present is very probable. It varies a good deal in size throughout the year, according to the weather conditions. We found it considerably swollen after heavy rains in October of last year, and it then measured about 350 feet from east to west, and nearly 100 feet from north to south. When it overflows, however, these limits are much exceeded. Mr Goodchild has favoured us with the following note on the geology of the Braid Hills, and the probable origin of the sheets of water found there. He says:—

The rock surfaces at the northern end of the Pentlands, and especially those of the Braid Hills, are grooved and furrowed to an extraordinary extent by rudely-parallel depressions, whose general direction ranges north-north-easterly. These do not follow the structural character of the rocks, and instead of coinciding with the outcrops of the softer and more easily destroyed parts of the strata, they cut across these, often at considerable angles. For this and other reasons these furrows are now generally regarded as of *glacial origin*. Many of the furrows in question are very uneven in depth, and the bottoms of some of them are locally excavated to such an extent that they form landlocked hollows, which are surrounded on all sides by solid rock at a higher level. Where the surface soil happens to be impervious water gathers, and these hollows are converted into small tarns.

The nature of the deposits left in these hollows is a matter of considerable interest to both biologists and geologists; as, owing to the fact that the tarns in question date from the close of the Glacial Period, we may expect to meet in them with remains of the various faunas and floras that have lived there from the close of the Glacial Period down to the present day.

The investigation of the geological deposits in this loch we have been unable to take up, seeing this would probably entail considerable labour, as draining and excavating,—though the results, as Mr Goodchild remarks, might be of considerable interest. Our attention has been confined to the living forms; and as these vary much from time to time throughout the year, six visits have been made up to the present date—viz., on May 2, July 18, and October 17 of last year (1896), and February 6, March 6, and April 24 of this year. Gatherings were taken on each occasion by means of a drag-net, and small quantities of the water, with aquatic plants and decaying vegetation, were also secured, for careful examination by the microscope at home, and subsequent despatch to specialists, as already mentioned. The gentlemen who have thus kindly favoured us with their help are Mr John Hood, F.R.M.S., Dundee, who is well known as an authority on the Infusoria and Rotifera, and who rendered material assistance to Mr Saville Kent and to Messrs Hudson and Gosse in their respective manuals on these groups; also our fellow-members, Mr James Terras, B.Sc., assistant to Professor Bayley Balfour, who is at present working out the filamentous algæ and confervæ of this loch,—groups with which he is well acquainted; and Mr P. H. Grimshaw, of the Museum of Science and Art, who has carefully examined the aquatic insects. Our thanks are very specially due to these gentlemen for the aid they have rendered and are still rendering us. Mr W. C. Crawford and Dr Davies, not to mention other members of the Society, have also taken a great interest in the work being carried on here.

Standing by the side of the Upper Elf Loch on a summer day, a few familiar aquatic plants may be at once noted.

Thus near the north-west end there is a somewhat luxuriant growth of the common rush and the pretty bog-bean, with such less conspicuous plants as the vernal starwort, the Canadian pond-weed or Anacharis, the water-crowfoot, and the duck-weed or Lemna—this last-mentioned plant covering large spaces with its minute leaves. At the south-east end the surface of the loch is covered with the yellow water-lily and the common pondweed or Potamogeton. The loch itself, though situated in a natural hollow, is free to the sky, not surrounded by trees, well covered with vegetation, and in a quiet, retired spot, not liable to be much disturbed. At night it is much frequented by wildfowl, and Mr Speedy informs us that he has often shot wild-duck here by moonlight, from the covert of the whin-bushes overlooking the loch. From the first survey of it, as already said, it was believed that it would yield good results for microscopists, and that these expectations have not been disappointed we shall now proceed to show.

Beginning with the motile algæ (Volvocineæ), there are present such forms as Chlamydococcus, Gonium, Stephanosphæra, Pandorina, and Volvox. These are most interesting plants, and very beautiful under the microscope. But perhaps the last named, Volvox globator, or the "Rolling sphere," is the most familiar form, and a few remarks regarding it may be given, as we have here the full differentiation of sex. The life-history of this interesting plant, through its various stages, was followed throughout the year. In the asexual or vegetative form of reproduction—the usual method of multiplication in Volvox—the mature plant simply breaks up and sets free the component "zoösporanges," and this may—and, indeed, generally does—go on throughout the year. But in the sexual generation, which begins in autumn, certain cells become changed into sperm-cells and others into germ-cells, both remaining for a time within the Volvox sphere, which is thus monœcious. From these two kinds of cells oöspores are formed, and when these reach maturity the parent cell breaks up and the oöspores fall to the bottom, where they remain all winter. In spring, with the advent of mild weather, the Volvoces "swarm," as it is termed, swimming actively about on the surface; but as the summer proceeds they again gradually sink. A few years ago, Dr Macfarlane, while assistant to Professor Balfour, found this sporadic alga in an old quarry by the side of the road near Granton, but after a while it disappeared as mysteriously as it had come, and has not been seen there again. If watched for, it may be observed in some other locality in our district, a warm spring day being the best time to find it. In the mild spring of 1896, as already mentioned, Volvox was found in great quantities in the water of the Upper Elf Loch so early as the end of March; while this spring, which was a very cold and backward one, it was several weeks later in being seen.

Mr Hood has identified a number of Desmids, these being somewhat abundant in this loch. Among them are Cosmarium, Euastrum, Closterium, Micrasterias, Ankistrodesmus, and several others. The species of Diatoms as yet observed are few. Diatoma vulgaris is abundant, D. elongata not so common, while Pinnularia viridis is very abundant. A stipitate or stalked form, first noticed by Mr Crawford, is also met with, especially in early spring—probably a young stage of Gomphonema.

The filamentous algæ, of which there are several genera and species, will be named by Mr Terras as they come into fruit, and will be given in our next paper. Spirogyra, Oscillaria, Rivularia, and Œdogonium have been noted.

Coming to the animal kingdom, and to its lowest division, the Protozoa,—those lively specks of protoplasm, the Amœbæ, are represented by four species. The testaceous form, Difflugia, has here two species, one of these, D. pyriformis, being very abundant. The Infusoria are both abundant and interesting. Retaining the old division into *Ciliata*, *Flagellata*, and *Cilio-Flagellata*, all three classes are represented. Among the ciliated forms are Paramœcium (two species), Coleps, Colpidium, Stylonychia, and the well-known bell-animalcule, Vorticella. In spring this last-mentioned interesting creature was found on the rootlets of the duckweed, which were studded with it; but in autumn they had left these quarters, and, instead of living separately, were massed together in groups, all in active motion on their long spiral stalks. Among the flagellate forms are the well-known Euglena (two species), Phacus (three species), Lophomonas, and Uroglena.

The cilio-flagellate class is represented by the familiar Peridinium (two species) and by Gymnodinium. All of these are figured and described in Saville Kent's 'Manual of the Infusoria.'

Proceeding to the second division of the animal kingdom, the Metazoa, the presence of the common hydra (*Hydra viridis*), belonging to the Cœlenterata, may be noted. It seems to be fairly abundant. But several members of the Annulosa are all well represented. Hair-worms, blood-worms, round-worms, and flat-worms are numerous; and the horse-leech (*Hæmopsis sanguisuga*) is also common. The most interesting members of this group, however—at least, to the microscopist—are the Rotifera. These are both varied and abundant, a few being rare forms, and it is expected that Mr Hood will be able to add to the list when gatherings to be procured in the coming summer are sent him. Those he has already identified were taken in early spring, which is not the best season for collecting them.

Messrs Hudson and Gosse, in their monumental work, 'The Rotifera, or Wheel-Animalcules,' divide the Rotifera into four orders—1st, *Rhizota*, the rooted, because the adult forms are fixed; 2nd, *Bdelloida*, the leech-like, swimming and also creeping; 3rd, *Ploïma*, the sea-worthy, swimming only; and 4th, *Scirtopoda*, the skippers, swimming and also skipping. The last order is a very small one, containing but one family, with two genera, and each genus with but one known species. This order is not represented in the Upper Elf Loch, so far as at present learnt, but the other orders are all well in evidence. The third order, that of "the sea-worthy," is here by far the largest, having as many as fourteen species present, representing nearly as many genera, and this number will no doubt yet be increased. Some forms, as Synchæta tremula, were very numerous; the rare Copeus caudatus was represented by a few examples, as well as the handsome Euchlanis lyra of Hudson. The second order—the "leech-like"—had three species of the genus Philodina, as well as the common Rotifer (*Rotifer vulgaris*), which was abundant. The first order—the "rooted"—had two representatives,—the pretty Horned Floscule (*Floscularia cornuta*), and another Floscule to be particularised presently. All these rotifers are figured and described in Hudson and Gosse's monograph, except the Floscule just mentioned and one of the "sea-worthy" order, Sacculus cuirassis. The Floscule not found in Hudson and Gosse is named Floscularia cucullata, and is a species found by Mr Hood near Blairgowrie in 1881. As only one specimen was got, and that one not in a healthy condition, it could not then be described. Mr Hood searched for other specimens for twelve years, until in September 1893 it was found near the same locality as at first, "in fairly large numbers, and in prime condition." Mr Hood figured and described this large and handsome rotifer in 'The Journal of the Quekett Microscopical Club' for April 1894; and, so far as we are aware, it has never been got in any other habitat than the marsh pool near Blairgowrie where Mr Hood found it, until now it is discovered to be present in this little Braid pond.

The other rotifer referred to as not figured in Hudson and Gosse's work, Sacculus cuirassis, was also first recorded by Mr Hood, who observed it in the exceptionally warm weather of May, June, and July 1893 in the domestic water-supply of Dundee, where it was very prolific; and associated with it, he says, were many rare forms, some of them new to Britain. This rotifer was figured and described by Mr Hood in 'The International Journal of Microscopy and Natural Science' in October 1894, where he remarks: "*S. cuirassis* appears to me to be a rare rotiferon, and not widely distributed, as I have failed to find it in the waters of any of the lakes of either Forfarshire, Perthshire, or Fifeshire. It seems to be as yet confined to Loch Lintrathen, Forfarshire"—whence the Dundee water-supply is obtained. Mr Hood adds that he has received a record of one example in water from Epping Forest in 1889; and now we have this other record, from the Upper Elf Loch.

As regards the presence in considerable numbers of animal and vegetable life in drinking-water, it may be added that this is by no means uncommon. In the 'Midland Naturalist' for 1880 there is a paper by Mr J. Levick on the Microscopical Organisms in the Birmingham water-supply, which shortly before that time had been taken over by the Corporation. In this water several rare Rotifers were found, besides Vorticellidæ and other Infusorians, while Desmids, Diatoms, and Entomostraca were present in large numbers.

Mr Levick, in his paper, suggests that "their presence should rather be considered as indicative of the general good quality of the water than otherwise, as some of them, at least, are known at home and abroad as the inhabitants of deep clear water only." The large majority of those who used this Birmingham water would doubtless not be aware of what it contained; while as regards microscopists, the 'Journal of the Royal Microscopical Society,' in noticing Mr Levick's paper, remarked that they, at least, would have good reason to rejoice for an abundant supply of these micro-organisms brought to, or rather within, their own door, without the drawbacks of pond-hunting!

We now proceed to notice the Entomostraca. Among the forms of this class obtained in the Upper Elf Loch, the Copepoda (or "oar feet" order) are specially interesting. *Cyclops vernalis*, for example, which has not yet been recorded for the Edinburgh district, has been found here; while another Cyclops, *C. bicuspidatus*, has only been previously recorded for this district from Duddingston Loch. Up to the present time no fewer than six species of *Cyclops* have been identified from this small sheet of water. The *Canthocampti* are also comparatively well represented: they comprise three species of *Canthocamptus*, one of *Attheyella*, and one of *Moraria*. *Canthocamptus minutus* (Claus), one of the three species referred to, was recorded for the first time in Scotland in the 'Annals of Scottish Natural History' for October 1895, from specimens found in Loch Leven, Kinross-shire; and though it has since been recorded from other localities, the Upper Elf Loch is a distinctly new station for it. *Attheyella pygmæa* (G. O. Sars), another of the Copepods from the Upper Elf Loch, has also only in recent years been recognised as a Scottish species. *Moraria Anderson-Smithi* (T. and A. Scott) was, as a new genus and species, added to our fauna in 1893. It has been observed in several localities in Scotland since that date, but its occurrence in the Upper Elf Loch is the first time it has been noticed in the Edinburgh district.

With reference to the Cladocera (the order with branched antennæ), it may be stated that *Daphnia pulex*, which was common in the gathering collected on the 9th of May, was scarce in that collected on the 18th of July: on the other hand, *Simocephalus* (*Daphnia*) *vetulus*, which was rare in the May gathering, was of frequent occurrence in the other. *Graptoleberes testudinarius*, *Alonella nana*, and *Ilyocryptus sordidus*, were also among the Cladocera observed. *Alonella nana*, though very small, is a pretty species, having its test adorned with numerous oblique parallel ridges, which are also slightly curved. As regards the Ostracods, generally known as "water-fleas," of the five species that have been identified, all, with the exception of *Cypris fuscata* (Juriné), are more or less common forms. Full lists of the whole of these species will be found in the tabulated results to be given in our second paper. No fewer than twenty-five species of Entomostraca have, so far, been identified as inhabitants of the Upper Elf Loch.

Advancing to the Arachnida, the pretty little vermilion water-mite (*Diplodontus*) is fairly abundant; and there are probably other members of the same family present, though they have not yet been observed. But the discovery of the Water-spider (*Argyroneta aquatica*) in this sheet of water, as recorded in the current number of the 'Annals of Scottish Natural History,'[1] is a very interesting one, showing as it does the prescience of an honoured past president of the Society, Mr A. B. Herbert, who, when he found the Water-spider at Balerno, making the first record of it for the Edinburgh district, predicted that it would yet be found nearer the city.

From the Arachnida to the Insecta is but a step; and Mr Grimshaw has kindly come to our aid in classifying and naming the aquatic insects. Of the Coleoptera, or Beetles, five genera are represented—viz., Hydroporus erythrocephalus, Linn.; Ilybius fuliginosus, Fab.; Agabus nebulosus, Forst.; Cœlambus inæqualis, Fab.; and Haliplus ruficollis, Deg. Of the Hemiptera, or Water-bugs, there are the following species of the Corixæ—viz., Corixa Geoffroyi, C. Sahlbergi, C. striata, and a fourth not yet identified.

Among the Insects the Caddis-worm falls to be noted—for though it is popularly called a "worm," this, of course, is a misnomer, seeing it is the larval stage of a four-winged fly. As a "worm" it is well known to anglers, who find it a deadly bait. There are nearly 200 British species of the Caddis-

[1] See 'Annals of Scottish Natural History' for April 1897, p. 126.

fly, classified according to the shape of the tube or case which the larva constructs to dwell in. The tube of the Upper Elf Loch species is either made of a leaf rolled up cylindrically, or of a hollow stalk, which are the forms adopted by the common genus of the Phryganea; or it is nest-shaped, and constructed of little bits of moss, &c., as is the fashion in the equally common genus Limnephilus. Whether the shape of the tube and the material composing it furnish correct data for classification is doubtful, at least in some cases, for the Caddis-worm seems simply to use whatever material comes handiest, or is most plentiful, for the construction of its tube. Experiments have been tried where the larva has been pushed out of its tube and dropped into a vessel of clear water containing beads or small pieces of coloured glass, and the "worm" at once proceeded to build a very pretty house from these materials. But this is by the way.

The Mollusca call for very brief notice. Though these are moderately frequent in the Upper Elf Loch, they have not been found specifically numerous, only four, or at most five, species having been observed, the names of which are as follows—viz., *Sphærium corneum*, *Pisidium nitidum*, *P. milium*, *P. pusillum*, and *Limnæa peregra*. The only molluscan species that calls for special remark at this time is *P. milium* (Held). This is the species described in Dr J. Gwyn Jeffrey's 'British Conchology' as *P. roseum* (Scholtz); but which, according to the compilers of the Conchological Society's list of British land and fresh-water shells for 1892, is not now considered to be Scholtz's *P. roseum*, but is referable rather to *P. milium* of Held (see 'Journal of Conchology' for April 1892, p. 64). In recording this, and the other species of Mollusca from the Upper Elf Loch, it is but right to state that all these three species of *Pisidia*, as well as *Sphærium corneum*, have been recorded from "a marsh on the Braid Hills" by Mr W. D. Roebuck, F.L.S., from specimens forwarded to him by Mr Wm. Evans; but whether the "marsh" referred to is identical with the Upper Elf Loch or not we do not know.

The Vertebrata need not detain us long, for only the Fishes and Amphibians are represented—the former by the ubiquitous minnow and stickleback, and the latter by the frog and the newt. In a paper by Mr Wm. Evans, read before the

Royal Physical Society in 1894, on "The Reptiles and Batrachians of the Edinburgh District," it is recorded that all three species of the newt have been found in "a pond on top of the Braid Hills," which is probably the same pond as the one we are now describing. At the Upper Elf Loch we have noticed the common smooth newt (*Molge vulgaris*) and the warty newt (*M. cristata*), but the rarer palmated newt (*M. palmata*) has not yet been observed by us. A specially large form of the common frog, raised to the rank of a species by some, is found at the Braids, and was noted by us near the loch.

In conclusion, we trust that the recital here given of the numerous and interesting forms of life observed in this small sheet of water may incite others to take up similar investigations. There is a peculiar pleasure in pond-work, as all who have tried it can testify. Even its uncertainty adds a certain charm and zest to the pursuit; and yet, though it is the case that one never can foretell what the exact results of a haul may be, it is seldom indeed that some forms of interest or of beauty are not secured. While spring and summer, as a rule, may be said to yield the best results, still even in winter the variety of life which may be got is surprising. In February of this year (1897) we found, on paying a visit to the Upper Elf Loch, that it was frozen over with thick ice from end to end, and the surroundings wore a very wintry aspect indeed. But, determined not to be balked, a hole was soon made in the ice, and a gathering taken from underneath it by the drag-net, which afterwards turned out to be very rich in some respects. Curious larval forms of crustacea were present; growing-spores, in different stages, of various motile algæ were numerous; desmids and diatoms were dividing on every hand; while rotifers of varied hue and shape were abundant. After being kept in an aquarium in the heat of a sitting-room for a few days, all these infinitesimal aquatic forms of life started into fresh vigour and loveliness, furnishing abundant material for the work of many hours with the microscope. While some periods of the year, therefore, are undoubtedly better than others, it can hardly be the case that the pond-worker will ever go unrewarded.

XI.—*PLANT ORIGINS.*

(Report from the Microscopical Section.)

By Mr W. C. CRAWFORD, M.A., F.R.S.E.

(*Read April 28, 1897.*)

At the beginning of the present session, the Council of this Society very wisely resolved to revive the Microscopical Section, which had been in a somewhat dormant state for a few years. In doing so, they appointed me Convener of the Section; and it is now my duty to give a short report of what the Section has been doing during the past winter. It was not easy to start at once in November to do good work, with material neither at hand nor bottled up for use. We had to find our material as best we could; and it might be more correct to say that this report is rather about what we have been trying to do than what we have actually accomplished.

We met fortnightly during winter, on Saturday evenings, from seven till half-past nine o'clock. Our plan was that the meetings should be co-operative in character—that is, each member, as far as possible, was expected either to collect materials for examination or to read up some special article bearing upon the work of the section. This was not easy to arrange, but as we believe it is the right way to proceed, we hope to develop the plan in future sessions.

The other fundamental idea was, that the Section should restrict itself to the study of one class of plants or animals each winter. When we limit our attention to a single class or group, we get more real knowledge than if we spread our studies over a wider field. The individual organism is the only real thing in living nature. Species, orders, and classes are generalisations which correspond more or less truly with the individuals which compose them. Asa Gray has very truly said, "species are judgments." On the other hand, we wish to avoid the extreme into which the past generation of naturalists fell, of contenting ourselves with collecting as many manifestly distinct individuals as we can, and so making up lists of the plants and animals of our district and doing nothing more. We want to reason from our individuals—how they work, and how this living cosmos works. The question which continually presents itself to all who occupy themselves with the study of living things is, How has the individual organism—this insect, or this oak, or this man—become what it is? When a variety suits its environment, it becomes lasting, and we call it a species; and as time goes on and a species preserves more and more the residual effects of previous environment, we call that heredity. If we study a group, even an order or a genus, we get to see the changes of form brought about by various causes from within or from without; and the simpler the organism which we select, the changes will be the more rapid and the more clearly seen. Hence we resolved to restrict our studies to one class, at most, each winter.

The great use of that splendid instrument, the microscope, is to help us to understand and interpret nature. To get ideas as to how nature works should be our aim, and if we cannot interpret her deeper meanings ourselves, the microscope will greatly help us to understand the interpretations abler men are giving of them. In biology, the great battle-field where the heroes of our time join in combat is the field of the microscope. There the modern Achilles challenges the modern Hector, not over the dead body of a Patroclus, but over the most elementary organism, the living cell; and the Troy which is to fall is that minute citadel of the elementary forces of life, the nucleus. When that citadel surrenders, when its workings are explained, it will be one of the greatest victories ever achieved—a victory due, as all such great victories are, to patient investigation and reasoning. Moreover, the nucleus has the most important part to play in fertilisation, in cell-division, very probably in cell-nutrition, and it may be the bearer of hereditary qualities, and so have the shaping of the destinies of the organism.

One of the best books on microscopic work ever written is Strasburger's—I mean, the German original, not the translation, which has been boiled down for examination purposes. Strasburger published an edition of his 'Botanisches Praktikum' in 1884, and another has just been issued. The difference between the two editions, although they go over quite the same ground, is striking. In the earlier one there is hardly anything said about making permanent preparations, and very few stains are mentioned; a microtome is discarded,—"sections may be made quite well with the hand." In this year's edition (1897) all that is changed. Many pages are devoted to microtomes, the sharpening of razors, embedding in paraffin, and so on; while all through the book very full instructions are given for the preparation of stains. The change in microscopic technique in these thirteen years has been enormous. Now we know that the course of development through which a race has passed is repeated to a greater or less extent in the life-history of the individual, and it would be well to follow the same law of recapitulation in our individual microscopical studies. We should begin to use our microscopes without microtomes, with very few stains, and, if possible, with living or fresh objects. The appearance of a living cell—that of Spirogyra or Tradescantia, for instance — is quite different from that of a dead cell, however carefully mounted.

There are, to my mind, three ways of using the miscroscope to advantage: (1) Examine the objects fresh, make the sections by the hand or by a freezing microtome, and use a few simple stains. Follow, in fact, such a book as Bower's 'Practical Botany' or Huxley and Martin's 'Practical Biology.' (2) Make collections to illustrate a particular group, such as fresh-water algæ or microscopic fungi. Many of these may be cultivated, and preserved permanently in fluid cells. (3) Use the more elaborate process of fixing, hardening, embedding, and so on, after becoming familiar with simpler methods.

The Microscopical Section resolved to occupy itself this winter with a class of plants which has much interest for the physiologist—the seaweeds and their fresh-water representatives. From the difficulty of getting specimens, we could not go on very methodically; still, we got examples in fairly good condition of most orders of British algæ. Of the brown algæ we had Fucuses and Laminarias, Cutleria, Dictyota, and Desmarestia; of the green, we studied a number in fertilisation and in fruit, such as Œdogonium, Vaucheria, and Spirogyra. We had Ulothrix, Bryopsis, and Codium. We observed the intercellular strands of protoplasm in Volvox, and we examined some of those enormous unicellular algæ, Valonia;

those equally interesting and highly developed single cells, Caulerpa; and those bundles of tubes, Udotea,—which all inhabit the Mediterranean, and specimens of which we got from the Marine Station at Naples. Nor did we neglect a representative of shell-boring seaweeds (Gomontia); and some of us got at Cumbrae examples of the Plankton flora, the curious Ceratium, and some ocean diatoms. Among the red seaweeds we had Nemalion, Delesseria, Rhodymenia, Ceramium, Bonnemaisonia, Gigartina, Plocamium, Dasya, Ptilota, Corallina, and others,—all these I have mentioned being in fruit. We had Oscillaria and Nostoc to represent the more degenerate blue-green forms.

[The report concluded with the exhibition of about forty lantern slides, to illustrate some of the inferences which might be drawn from these winter studies. Starting with the assumption that plant life in its simplest forms first appeared in the ocean, not far from the shore, the course was traced which a simple little green sphere with a nucleus probably followed in passing from the life in the sea to life on land, on its way to become the land plant with "tapering stem and bright consummate flower." Reproduction in the green marine algæ, it was pointed out, is altogether of a very simple character. The ocean is the home of uniformity, of vegetative equality, and of conservatism. It was in adversity that sex was developed. When the little simple tubular cells got into lagoons and fresh-water lakes, where the water was often dried up, they developed a complicated process for preventing the extinction of the race. Reference was also made to the splendid investigations of Klebs in cultivating algæ, and some of the inferences that may be drawn from them.]

MICROSCOPICAL AND NATURAL HISTORY EXHIBITION.

On February 24 the evening meeting took the form of an exhibition of microscopical and natural history specimens, laid out in the Hall at 20 George Street. A large number of slides, prepared by members, were shown on the screen and under microscopes. A noteworthy feature of the evening was a collection of natural history specimens from the Biological Station at Millport, kindly brought by Captain Turbayne, Curator of the Station there. The collection included a number of specimens from the Zoological Station at Naples, showing the state of perfection at which Dr Dohrn and his assistants have arrived in the way of fixing and preserving marine animals, so as to show as nearly as possible their appearance in the living state. The Millport specimens included representatives of the Cœlenterata, the Echinodermata, the Crustacea, the Mollusca, and fishes. There was also shown a beautiful set of preparations, in spirit, illustrating the development of the crayfish, the frog, and salmon-trout, from the egg upwards. The President, Dr Davies, gave a very interesting account, illustrated by lantern slides, of the history of the Millport Biological Station. The following is a *résumé* of the paper read on the occasion :—

The history of the Millport Marine Biological Station begins in the year 1882, when a sum of about £1400 from the surplus funds of the Edinburgh Fisheries Exhibition, held in that year, was handed over to the Scottish Meteorological Society for the purpose of establishing a Marine Zoological Station. Subsequently an application was made to Government for additional funds, but without success. However, with the assistance of Dr John Murray of the Challenger Expedition, a start was made. In the autumn of 1883 Dr Murray purchased the little vessel now known as the Ark, and this, having been fitted up as a biological laboratory, was moored in the old quarry at Granton, which had been leased to Dr Murray at a nominal rent. In the meantime a small steam yacht, the Medusa, had been furnished with all the most modern appliances for carrying on scientific research. This, with the Ark and some rowing boats, formed the establishment of the Scottish Marine Biological Station, which was opened at Granton on April 14, 1884—the opening ceremony being, in the unavoidable absence of Professor Haeckel of Jena, performed by Dr Murray, before a large gathering of scientists and others.

The work of the station was at once commenced under the supervision of an efficient staff. After the lapse of a year a new laboratory was established on shore, close to the old quarry, and the Ark was removed to Millport on the Clyde, where it still remains, though shortly to be superseded by the more permanent station now being erected on the shore. Thus greater facilities were afforded for obtaining a knowledge of the fauna and flora of the east and west coasts, and of the relations existing between them.

The Clyde area has long been a favourite hunting-ground with naturalists, teeming as it does with varied forms of animal and vegetable life; whilst in the landlocked lochs collecting may be pursued on shore, or by dredge in from 60 to 100 fathoms, and in weather which would render it impossible to work on a more exposed coast.

The late David Robertson, LL.D., for many years strongly advocated Millport as a centre for a permanent station for the study of Marine Zoology and Botany, and in the autumn of 1893 he and Mr George M'Crie of Glasgow got a committee formed who took the matter up, and appealed to the public for funds to enable them to erect a station at Millport. Having collected £800, building was commenced in August 1896, when Dr Robertson cut the first sod. The foundation-stone was laid on October 17 in the same year, but Dr Robertson was unable to be present, being confined to bed by serious illness, from which he died on November 20, within eight days of completing his ninetieth year.

The new station is situated near Keppel Pier, and is of two stories. On the ground-flour is the caretaker's house, with the laboratory, which can be converted into ten separate workrooms if necessary. The top flat is, with the exception of a small private room, entirely devoted to the purpose of a museum, lighted from the roof and by one large window facing south.

NOTES ON THE SUMMER EXCURSIONS OF 1896.

By Dr DAVIES, President.

I.—Linlithgow.

The summer meetings commenced on Saturday, May 2, when an excursion was made to Linlithgow, with the object of visiting the Palace and exploring the loch and the surrounding district. The party spent some time in the town, and, under the guidance of Mr T. A. D. Wood, inspected the Palace and the adjoining Church of St Michael.

The burgh of Linlithgow is of very ancient origin. Sibbald says that it was founded by King Achaius, and that there was once here a stone cross bearing the name of King Cay's Stone, which he regarded as a corruption of King Achaius's Stone. In 1298 Edward I. passed through the town on his way to Falkirk, and in 1301 he took up his winter quarters there and erected a castle, part of which still exists at the north-east corner of the Palace. The town at one time contained a number of houses belonging to the Knights of St John, all of which have long since been removed. The Cross Well, built in 1807, occupies the site of the Market Cross, originally erected in 1620. The house from which Hamilton of Bothwellhaugh shot the Regent Murray, Jan. 20, 1570, and which is said to have been the property of Hamilton, Archbishop of St Andrews, stood in the High Street, but was demolished some years ago.

The Palace, of which only the ruins now remain, must have been one of the finest in Scotland. It stands to the south of the loch, and the present building has been erected at various periods, mostly from the reign of James IV. to that of James VI. It remained habitable till 1746, when it was destroyed by fire. It has recently been to some extent restored. The room in which Queen Mary was born, Dec. 7, 1542, is in the western wing. In the quadrangle are the somewhat dilapidated remains of an elaborately carved fountain, from which that in front of Holyrood is said to have been copied.

The Parish Church of St Michael stands to the south-east of the Palace. It was founded by David I., and is still used for public worship. It was in an aisle on the south side of this church that James IV. saw the supposed apparition which warned him, in vain, against the war with England. A fine stained glass window has recently been erected in this church to the memory of the late Sir C. Wyville Thomson by the officers of the Challenger Expedition.

II.—Granton.

An evening excursion to Granton took place on Wednesday, May 6, under the leadership of Mr J. A. Johnston. Amongst the plants gathered were—Sagina maritima, Plantago maritima, Myrrhis odorata, and Veronica serpyllifolia. A very pronounced variety of Taraxacum officinale was also found. The chief object of the excursion, however, was to examine the geology of the district, and this was fully and clearly explained by the leader.

III.—Inverkeithing and St Davids.

A joint excursion of our Society and the Kirkcaldy Naturalists' Society took place on Saturday, May 16, to Inverkeithing and St Davids. At Inverkeithing are still found the vestiges of the Dominican and Franciscan monasteries which once existed in the town; and in their immediate vicinity is a building now known as "The Inns," which is said to have once been the residence of Annabella Drummond, Queen of Robert III., who certainly died at Inverkeithing in 1403. To see this ancient building was one reason for our visiting Inverkeithing. The parish church, where is a curious old font, was also visited. The party then proceeded by the coast to St

Davids, where, chiefly on the ballast-heaps, several interesting plants were collected, amongst them being Melilotus arvensis, Brassica tenuifolia, Poterium Sanguisorba, and a species of Sonchus, not yet identified. The geology of the district was also minutely explained by Mr A. Campbell and Mr Goodchild.

IV.—Duddingston Loch.

Duddingston Loch was visited on the evening of Wednesday, May 20, the Secretary acting as leader. Amongst the plants gathered were—Hippuris vulgaris, Scirpus palustris, Phalaris arundinacea, Phragmites communis, Galium palustre, Sium angustifolium, Epilobium palustre, Stellaria uliginosa, &c.

V.—Dunbar.

An excursion to Dunbar was arranged for Saturday, May 30, when a few plants were gathered, amongst them being—Plantago Coronopus, Hyoscyamus niger (in flower), Glaux maritima, Astragalus hypoglottis, Œnanthe crocata, &c. The excursion was, however, essentially a geological one; and Mr J. G. Goodchild, who acted as leader, drew the attention of the party to the geological features of the district, and explained these in so lucid a manner as to secure the hearty thanks of the party.

VI.—Craigmillar.

An evening excursion to Craigmillar took place on Wednesday, June 3. This was a geological excursion, under the leadership of Mr J. A. Johnston, who explained the geology of the district in a most interesting way.

VII.—The Bass Rock.

On June 13, a party numbering about sixty left at midday for North Berwick, *en route* for the Bass Rock, under the guidance of Mr W. Eagle Clarke, to see the vast number of sea-birds which resort there for the breeding-season. The rock was reached from Canty Bay by fishing-boats—not without some difficulty, owing to the dense fog which prevailed;

but fortunately the sea was calm, so that a landing was easily effected.

The innumerable sea-birds were an object of much interest to the members, and a beautiful photograph of a portion of the rock with the birds resting upon it was taken by one of our members, Mr Alister Murray.

Two rare plants are found on the Bass—the Sea-beet (*Beta maritima*) and the Tree-mallow (*Lavatera arborea*), the latter probably introduced.

VII.a.—Dredging Excursion.

On the same day as the Bass Rock excursion, the Fishery Board steamer, The Garland, was placed at the disposal of the Society, through the kindness of Dr Wemyss Fulton; and, under the guidance of Mr Thomas Scott, about forty members availed themselves of the opportunity of seeing the practical operations of dredging and trawling. The weather being favourable, numerous interesting examples of the marine fauna of the district were obtained.

VIII.—Musselburgh and the Esk.

An evening excursion took place on Wednesday, June 17, under the leadership of the Secretary, to Musselburgh and the Esk. The evening was devoted to botanical work, and amongst the plants gathered were Stellaria nemorum, Carduus tenuiflorus, Vicia sativa, Tanacetum vulgare, Scrophularia nodosa, S. Ehrharti (a new station for this plant), and several species of Salix, &c.

IX.—Millport.

A dredging excursion to Millport was arranged for Saturday, June 20, but the day being very unfavourable, only ten members ventured. Leaving the Caledonian Station at 9 a.m., and travelling *viâ* Wemyss Bay, the party, under the leadership of Mr Crawford, reached Millport soon after mid-day, but, greatly to their disappointment, the state of the weather prevented dredging operations being undertaken. They, however, visited the marine station then located in the little vessel called the Ark, where they were most courteously received by the curator, Captain Turbayne; and here and in botanising on the shore a very interesting day was spent.

Amongst the plants gathered on the shore, mostly near Keppel Pier, were Lobelia Dortmanna, Cotyledon Umbilicus, Œnanthe Lachenalii, Ligusticum (Haloscias) scoticum, &c.

X.—Crichton and Borthwick.

On Saturday, June 27, under the leadership of the Secretary, there was an excursion to Crichton and Borthwick. Reaching Tynehead Station soon after two o'clock, the party proceeded at once to Crichton Castle, noticing the limestone quarries and the church on the way.

The massive ruins of the once magnificent castle of Crichton stand above the right bank of the Tyne, and a little to the south of the ancient church. This church, originally collegiate, for a provost and eight prebendaries, was founded in 1449, and dedicated to SS. Mary and Kentigern. The original plan was cruciform, but the nave was never built, and it now comprises a chancel with transepts and a massive square saddle-backed tower.

After exploring the castle, the party botanised through the glen to Borthwick, where the castle, built by Sir William (afterwards Lord) Borthwick, and which still remains in perfect preservation, one of the finest examples of the peel towers of Scotland, was visited. It measures 74 feet by 69 feet, the height to the battlements being 90 feet, and the walls at the lower part 15 feet in thickness.

Amongst the plants gathered during this excursion were Carex stellulata, C. flava, C. arenaria, C. glauca, and C. paludosa; Filago germanica, Leontodon hispidus, Hieracium aurantiacum, Sambucus Ebulus (a new station), and Lycopsis arvensis.

XI.—Ravelston.

On Wednesday, July 1, there was an evening excursion to Ravelston, where the party was most kindly received by Miss Murray Gartshore and Mr Keith Murray, by whom they were shown over the policies and gardens.

Ravelston, situated near Corstorphine Hill, belonged at the end of the sixteenth century to George Foulis, whose son was created a baronet in 1661. The second baronet, Sir Archibald, was "out in the '45," and was executed at Carlisle for his share in that unfortunate affair. On succeeding to the estate of Dunipace he took the name of Primrose, and in 1726 sold Ravelston to Alexander Keith, a descendant of the third Earl Marischal. His son Alexander (1705-1792) built the present mansion, and here he was often visited by his kinsman, Sir Walter Scott, who is said to have taken from the old-fashioned formal gardens some of the features of Tully-Veolan in 'Waverley.' The son who succeeded to the estate in 1792 received a baronetcy on the occasion of the visit of George IV. to Edinburgh in 1822; and on his death in 1832 Ravelston passed to his son-in-law, Sir William Keith Murray of Ochtertyre, whose son, Sir Patrick, sold it in 1872 to his uncle, John Murray Gartshore, Esq., the father of the present proprietrix, by whom extensive additions have been made to the house.

XII.—Dalkeith.

On Saturday, July 11, there was a botanical excursion through the grounds of Dalkeith Palace, under the guidance of the Secretary, when several interesting plants were gathered, amongst them being — Campanula latifolia, Scrophularia Ehrharti, Circæa lutetiana, Lastrea rigida, Cystopteris fragilis, Fistulina hepatica, Cantharellus cibarius, Amanita verna, and A. rubescens, &c.

XIII.—Slateford.

Under the leadership of Dr Watson, an evening excursion took place on Wednesday, July 15, to Slateford. Amongst the plants collected were — Bromus asper, Melica uniflora, Circæa lutetiana, and Lycogala epidendron.

XIV.—Balerno.

An entomological excursion to Balerno was arranged for Saturday, July 25, but, owing to the unfavourable weather, it had to be postponed until Wednesday, the 29th, when, under the leadership of Mr Grimshaw, a party of seventeen started for Balerno. The weather was again unfavourable, however, and nothing could be done, though Dr Watson discovered Goodyera repens in the district.

XV.—Fungus Foray.

The annual Fungus Foray took place on Saturday, Oct. 3, to Roslin Glen. Thirty-one species of fungi were gathered, but nothing of special interest was met with.

EXHIBITS IN NATURAL HISTORY.

Among the objects of interest in Natural History exhibited during the Session were the following:—

By Mr P. Miller, Linlithgow.

A living Giant Kingfisher, or Laughing Jackass (*Dacelo gigas*).

By Mr W. Ranken.

A collection of rare Japanese, Indian, and other Conifers, from Powerscourt, Wicklow.

By Mr A. B. Steele.

Curious bird-shaped flowers of *Clianthus*, from Australia.

By Mr Grimshaw.

Specimen of the Camberwell Beauty (*Vanessa Antiopa*, L.), from the island of Foula, Shetland.

By Mr Geo. Brotherston.

A pair of live Parson Finches (*Poëphila cincta*) from Australia.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Society was held at 20 George Street on the evening of Wednesday, October 27,—Mr Ranken in the chair.

The Treasurer, Mr George Cleland, submitted his statement of income and expenditure for the past year, which showed a balance in favour of the Society of £30, 15s. 10d.

The Secretary read the following Report:—

The number of meetings of the Society held during the Session just ended was the same as in the previous one—viz., 6 indoor and 16 field meetings. The attendance at the former was better than for the past year or two, and the papers read at these meetings were all by members. The aggregate attendance at the field meetings was 324, or an average of 20 at each meeting, and there appeared to be a reviving interest in the work done at these excursions. Fortnightly meetings for practical work with the microscope were also held during the winter months, and the convener of this section, Mr Crawford, is so satisfied with the attendance and work done during the past Session, that he again offers the use of his laboratory to the members for another Session. The Society is greatly indebted to Mr Crawford for this offer and for other kindnesses.

The working up of the flora of the county is progressing, and I hope to be able soon to say something more definite about it.

During the past year we have lost by death two valuable members—Mr C. A. Sonntag and Mrs Davies. Other two have withdrawn their names from the roll, and twenty-seven new names have been added, making at the close of this Session a total of ordinary members of 168.

The Office-bearers for next Session were then balloted for, with the following result: Dr Davies was re-elected President; Mr T. Wright was elected Senior Vice-President; Messrs T. C. Day, F.C.S., and W. Ranken were elected Vice-Presidents; and T. B. Sprague, M.A., LL.D., W. C. Crawford, M.A., F.R.S.E., Lieut.-Col. Pennefather, and Mr E. Denson were elected to fill the vacancies in the Council; Mr John Lindsay was re-elected Editor of 'Transactions'; Mr A. B. Steele was re-elected Secretary; Mr George Cleland was re-elected Treasurer; and Messrs R. C. Millar, C.A., and J. T. Mack were re-elected Auditors.

PRESS NOTICES OF VOL. III., PARTS IV., V.

"The 4th and 5th Parts of the 'Transactions' of the Society are now before us, and we are pleased to find that the Annual Report is satisfactory. The papers included in these Parts are so many testimonies to the skill of their (mostly) well-known writers. Among the most interesting and botanical subjects treated of are—"Notes on Japan," by Dr Watson; "Mr G. Don's Specimen of Holy Grass," by A. B. Steele; "Poisonous Plants," by M. King; and "Popular Delusions in Natural History," by Dr Traquair. There is an "In Memoriam" notice of the late Dr Robert Brown, by A. E. Davies, Ph.D., illustrated with a good and pleasing portrait. Dr Brown was, it may be remembered, the first President of this Society, and died in October 1895."—*The Gardeners' Chronicle*, December 5, 1896.

"In the 'Transactions of the Edinburgh Field Naturalists' and Microscopical Society' for 1894-96 we notice papers on Daubenton's Bat (*Vespertilio Daubentoni*), as observed and captured in Glen Dochart, Perthshire; the Geology of Arran; Trout, and their influence in purifying water; the Little Auk; Poisonous Plants; the Habits of Gulls; Popular Delusions in Natural History; and Researches on Snake Poison, with special reference to the work of Dr Cunningham of Calcutta."—*Nature*, December 17, 1896.

LIST OF PAST PRESIDENTS.

Dr Robt. Brown (*deceased*),	1869.	Mr John Walcot,	1879–1882.
Mr R. Scot Skirving,	1869–1874.	Mr A. B. Herbert,	1882–1885.
Mr Wm. Gorrie (*deceased*),	1874–1877.	Mr Symington Grieve,	1885–1888.
Rev. R. F. Colvin (*deceased*),	1877–1879.	Dr William Watson,	1888–1891.
		Dr Sprague,	1891–1895.

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VOL. III. PART VII.

TRANSACTIONS

OF

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SESSION 1897-98

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SESSION 1897-98.

I.—*THE ILLUSTRATION OF BIRDS' NESTS BY PHOTOGRAPHY.*

By Mr H. RAEBURN.

(Read Nov. 24, 1897.)

It has long been a desire among ornithologists that a series of accurate and reliable representations of birds themselves, with their homes and haunts, should be obtainable. Of course we do not despise the many charming woodcuts, drawings, &c., of numerous able artists; but the older of these are usually sadly inaccurate in detail, while the work of the newer school, though more true to Nature, still leaves something to be desired as regards actual life and truth. The manifold and ever-increasing application of photography to industrial, scientific, and artistic objects pointed out the possibility that here we have a means of obtaining those ornithological records which we desire. Accordingly, we find that within the last few years almost a new school of bird illustrators—using that term to mean the bird as a living, sentient creature, and not as an expressionless stuffed mass of feathers — has arisen. The difficulties in the way of photographing wild birds themselves are, however, enormous, and camera ornithologists have been practically forced to confine their efforts to the obtaining of photographs of birds' haunts in the nesting season, with pictures of their nests, eggs, and young,—only a few of the tamer species submitting themselves to the camera lens, rather than abandon their charge.

Among those who have worked at this difficult subject, perhaps no one has been more successful than Mr R. B. Lodge of Enfield, brother of the well-known bird-illustrator, Mr G. E. Lodge. He has, with marvellous patience and skill, succeeded in obtaining some very good pictures of various species of birds on the nest or feeding young. An interesting account of his method of work will be found in the 'Photogram' for October and November 1894. Though birds'-nest photography is only of recent date, a large number of ornithologists have already adopted the camera. Among others, Dr R. Schufeldt of the New York Museum has got some very good results, showing nests of various American species. The first book dealing exclusively with this subject was by the Messrs Kearton—'British Birds' Nests,' published by Messrs Cassell & Co. in 1895; and the same authors have recently published two more volumes on the same subject. There is also being at present issued in parts, by the firm of David Douglas, Edinburgh, an *édition de luxe* of birds'-nest photographs, under the title of 'Among British Birds in their Nesting Haunts, illustrated by the Camera,' by Mr Oswin Lee. The title-page of vol. i. of Messrs Harvie-Brown and Buckley's 'Fauna of the Moray Basin,' representing a heron sitting on her nest, is reproduced from a photograph from life by Mr Lee, and is one of the most successful things ever attempted in this very difficult line of art. Perhaps it takes a naturalist who is also a photographer to fully understand the difficulties. It will thus be seen that already a considerable literature has sprung up on this subject.

A few words may now be given on the methods and apparatus used by me in obtaining photographs of birds' nests. I may premise that the entire labour of finding the nests, as well as of reaching and photographing them, developing the negatives obtained, and preparing the slides therefrom, has been done by myself without assistance, so that I trust allowances will be made for amateur work. People who know nothing of photography, and even a few who do know something of it, have asked me if I used a kodak or hand-camera to obtain nest photos with; and they seemed surprised when I explained that the work was by no means a case of "press the button and we do the rest," and that a hand-camera was in nearly every case utterly useless. It was as far back as 1891 that a friend showed me some prints of terns' nests. These he had got himself with a quarter-plate stand camera, after having wasted a lot of time in attempting to work with a kodak. In the spring of 1893 I began to photograph on my own account. I used till the summer of last year a quarter-plate Baroness type camera, with a special adaptable stand, and for lightness an Eastman roll-holder and film. But the sole advantage possessed by a film is its lightness: in every other respect it is far inferior to plates or cut films, is much more troublesome to manipulate, and considerably more expensive. A couple of years ago a good deal was heard of the capabilities of the telephoto lens, but after a trial of this I was forced to come to the conclusion that for this class of work it is practically useless, on account of the enormously increased exposure required with the telephoto, and the greatly increased size and weight of the apparatus necessitated by the very heavy lens. Mr Lodge has, however, obtained some results with a modification of his own of the telephoto lens; but, as a rule, he works without it. In the summer of 1896 I obtained a Shaw's pocket half-plate camera, and adopted cut films. These I have found usually very satisfactory, though after all there is nothing so good as glass plates; but their weight in the case of half-plate size becomes a serious consideration when one has to carry the whole outfit—camera, stand, lenses, dark slides, and plates, &c.—for twelve or fourteen hours at a stretch over the highest mountains in Britain. The Shaw's pocket half-plate is a wonderfully light and compact little instrument, but has the fault of not extending sufficiently far to permit of close views being obtained of small nests. A light double-extension half-plate camera of ordinary make would probably be more generally suitable.

As regards the difficulties encountered in photographing birds' nests, these are undoubtedly very great, especially if any nests beyond those of the ground-building species are attempted. Of all the enemies of the birds'-nest photographer, the greatest is wind, and the lighter the camera the more is this felt. It is no slight trial to endurance and temper to have to cling in a precariously balanced position on the ledge of some dizzy cliff in half a gale, while attempting to obtain a picture of the nest and eggs of a raven, an eagle, or a peregrine falcon. The weather in the nesting-season is often severe, and rain, hail, and sleet, separately or together, must frequently be faced. But the reward, when a successful photograph of the nest of some rare species is obtained, compensates for many disappointments.

[A large number of photographs of birds' nests and their eggs were then thrown on the screen, and Mr Raeburn was highly commended for the labour he had undertaken in this important branch of science, and for the most successful results he had obtained.]

II.—*MICROSCOPIC LIFE.*

By Miss SPRAGUE.

(*Read Dec. 22, 1897.*)

About three and a-half years ago my father and I began to study microscopic life together. At first we used simply to collect specimens, and content ourselves with looking at them, and identifying them when we could, which was not very often; but in October 1894 we bought a book with blank pages, and began to record our finds, both by drawings and written descriptions. For some time we found it very hard work to identify the various objects we came across; but we gradually became familiar with them, partly by finding them repeatedly, and partly by reading and consulting books on the microscope. Those we have found most useful are the 'Micrographic Dictionary,' Cooke's 'Ponds and Ditches,' Carpenter's 'Microscope and its Revelations' (edited by Dallinger), Cooke's 'British Fresh-water Algæ,' and the Rev. J. G. Wood's 'Common Objects of the Microscope.'

We have obtained most of our specimens from hunting-grounds near at hand, such as the water-trough in the Queensferry Road, a water-trough and a small pond at House o' Hill Farm, our own little Marchfield pond, Ravelston Quarry, and the Marl Pit. We have also once or twice collected gatherings from the Canal, the Elf Loch on the Braid Hills, and the pond in the Botanic Garden, and these places are all very full of interesting objects. We can always count on finding some objects in special places of their own, as for instance Euglenas on a spot in the Queensferry Road close by Blinkbonny Farm after rain, and Chætophora endivæfolia in Ravelston Quarry.

When collecting from ponds, we use a small muslin net fixed on a wire hoop at the end of a long stick, which can be unscrewed to half its length if desired. We scrape the surface of the mud gently with the hoop, and then empty the contents of the net into a wide-necked glass jar filled with water. It saves trouble to have a lid or cork for the jar, and to carry it by a looped string.

Among our earliest friends were the Rotifers: it is very interesting to watch one feeding busily among algæ, attached by a strong forked tail to some support, while the wheel or circle of cilia at its head is in rapid motion, setting up currents in the surrounding water, and so drawing food-particles into the creature's mouth. When the rotifer wishes, it can detach itself and swim about freely. We used to bottle a good many of our gatherings and open the bottles again after some time, and we usually found that the rotifers were longer-lived under these unnatural conditions than most of the other animal organisms. We used often to open our old bottles, but have given up doing so, as nearly all the organisms, whether animal or vegetable, soon die in a corked bottle, and then the contents smell very bad.

From time to time we have found a great number of Vorticellas of different kinds. They are graceful little bell-shaped things, generally anchored by a long flexible stem, which at any alarm contracts suddenly into a short spiral, and then stretches more slowly out to its full extent, when the cilia at once begin their busy movements. We have seen as many as forty or fifty vorticellas at once in the field of view.

The Infusoria (to which the vorticellas belong) are an interesting class of creatures, and many of them are very common, though it is rather difficult to identify them on account of their swift motion. They are generally colourless, ciliated, and exceedingly active. Those we know best are the Coleps, the Slipper-animalcule, Swan-animalcule, Stentor, Euglena, Astasia, Arcella, Difflugia, Vaginicola, Sun-animalcule, and Amœba. The five last mentioned are easily studied, as the Vaginicola is always anchored, and the other four move quite slowly.

Vaginicola is a beautiful little creature: it lives in a clear glassy tube, fixed at the tapering end to some anchorage, and open at the other end. When it wants to feed, it stretches itself out till the fringe of cilia expands like a flower, just beyond the tube. If disturbed in any way, it contracts with a jerk, and remains for a time motionless at the bottom of the tube. We occasionally find two inhabitants in one tube, owing to the creature having divided.

The Euglenas are organisms which have sometimes been classed as animals, but are now generally placed in the vegetable kingdom. The leaf-euglena is perhaps the prettiest: it is like a bright green leaf, with a red spot at the broad end, and a flagellum (that is, a long, slender, flexible appendage) at the tip, and it moves very rapidly. The entire surface of ponds is sometimes coloured green with euglenas, and they seem especially fond of manure ponds.

We had a curious experience with the Astasia, which is a closely allied species. We were staying in the New Forest in May 1896, and went, as in duty bound, to see the Rufus Stone, which marks the place where the king was killed. There is a pond in the neighbourhood, where Sir Walter Tyrrell is said to have washed his hands after the deed; and at certain times of the year the surface of this pond is a bright red colour. We went to see it one Monday, and found that it quite came up to its reputation, being of a most sanguinary hue; but by the following Wednesday, when we happened to pass the place again, it had almost completely changed to bright green. We took some specimens home with us, and on examining them under the microscope, found that the colour was due to thousands of these tiny organisms, the Astasias; and we suppose they must have changed colour in that short time (two days). The 'Micrographic Dictionary' says that probably the colour of the species is not constant, but that the

Astasia has not been thoroughly studied yet. Dr and Mrs Watson were staying in the New Forest just before we came, and we are indebted to them for calling our attention to the pond.

The Amœbas, which are like animated morsels of jelly, have often entertained us with their odd movements. They progress by stretching out a pseudopod or two, and then creeping or rather flowing after them, till the whole body has moved forward. When an amœba wants to eat anything, it stretches out a pseudopod on each side of the coveted object, and gradually flows completely round it. In this way the same part of the amœba serves first as mouth and later on as digestive organs. The amœba proper moves very slowly, but we have seen other species which are wonderfully active.

We once saw an instance of multiplication by division in an Infusorian somewhat resembling a stentor. When we first caught sight of our specimen it was swimming about very fast, and looked like one creature with a curious appendage. This appendage was completely absorbed into the main body for a little time, and then reappeared more plainly, when we saw that it was a small facsimile of the larger portion. Soon the connecting band became longer and thinner; and at length, while we were watching, the two portions twisted themselves different ways till the narrow link broke, and each creature swam off on its own account. We once saw a stentor in process of division by oblique fission.

We have not found so much variety among the larger animals: the commonest are nematodes and water-fleas, and larvæ of different kinds. The nematodes are lively little things, and create a great disturbance on a slide. The first specimens we saw were dead, and curled up in odd positions, and we took them for some vegetable organism such as Closterium, till later on the same evening we found a live one, to our great surprise. The water-fleas we are most familiar with are Daphnia pulex, D. vetula, Cypris, Cyclops, Canthocamptus, and Chydorus; and we have once or twice come across Alona. In October 1895 our pond at Marchfield was swarming with Daphnia pulex, but in July 1896 it was full of D. vetula, with a sprinkling of Chydorus and Cyclops. They are all very lively, and in order to get a good look at them, we have generally to put a good deal of chloroform on the slide. Daphnia pulex and D. vetula are particularly interesting, as they have two kinds of eggs. The summer eggs develop in the usual way within the parent's shell, till the young are able to look after themselves. The winter eggs, however, are contained in a case called the ephippium, which after a time falls off the Daphnia's back, and floats about in the water by itself while the eggs within it are developing. The winter eggs are larger, and fewer in number, than the others.

The water-bear deserves mention, though we have only found it once or twice. It is a curious little creature belonging to the Arachnidæ, and has eight short thick legs furnished with strong claws. It appears to walk slowly about among the algæ, catching hold of them with its claws, and biting them in a most businesslike way, and really gives one the impression of being an intelligent little animal.

We were for a time chiefly interested in vegetable life, but here the difficulty of identification is much greater, as many of the algæ, for instance, can only be identified when in fruit. Diatoms are by far the commonest vegetable organisms in the microscopic world: we must have found a good number of different kinds, but we have only identified a few, such as Meridion circulare, Melosira varians, Diatoma vulgare, Gomphonema, and Cocconeis. We found half-grown specimens of Meridion circulare over and over again for some time, and were uncertain of its identity; and when we at last came across a specimen which completed and more than completed the circle, we wrote down the name triumphantly, feeling that it was quite a red-letter day. Diatoma vulgare is interesting on account of the curious way in which its frustules are united: we have often found this species in horse-troughs, which are generally good hunting-grounds, as the water is clear and in constant motion. Cocconeis sometimes grows so thickly on an alga as to cover it almost completely with its little oval shells. We tried some time ago to mount an alga overgrown with it, but not with much success: it would be much easier to mount the Cocconeis separately.

In the marl pit at Davidson's Mains we have several times found quantities of a filamentous diatom, which we think is

Fragilaria capucina. It looks black in the water, but when a number of filaments are dry and lying upon each other they have a greenish metallic lustre. When mounted singly they are nearly colourless and transparent.

The organism to which we have devoted most time and attention is the diatom Melosira varians. This is a filamentous diatom which grows very profusely in the little pond at Marchfield. We came across it very early in our investigations, and were for a long time greatly puzzled as to its nature. It grows out from the side-walls of the pond, extending to a distance of six inches or more. The filaments are very fragile, so that it was not possible to say whether any individual filaments extended to that length. We first supposed it was a diatom because the endochrome is not green, but yellowish brown of various shades, occasionally quite dark brown. But we could discover no other characters of a diatom in it; and when at last we found it in fructification—the cylindrical cells taking the form of perfectly round globes, with two projections at opposite sides—we thought this was a development that could not take place in a diatom, and that the organism must therefore be an alga. On carefully and repeatedly looking through the plates in Cooke's book, we saw nothing resembling the organism, although at one time we thought it had some resemblance to an Œdogonium. At last we found figures of Melosira varians and M. nummuloides in the 'Micrographic Dictionary,' and of three species of Melosira in Carpenter's book on the microscope. The latter show the globes above-mentioned, and first gave us a clue to the name. The organism seems well to deserve its specific name of *varians:* the cylindrical filaments are of different breadth as well as of different colours, the broader being as a rule the darkest in colour; and when first examined, it is somewhat difficult to realise that they are cylindrical, as the cells look like a series of brick-shaped bodies fastened end to end, and there is no striation upon the outside, or other markings that are usually found on diatoms. (Since writing the above, we have once or twice seen slight striation; but it is very faint, and needs good illumination.) In the course of our investigations, however, we frequently found the empty cells, sometimes broken, sometimes whole; and when a broken fragment is seen obliquely, its cylindrical character is at once recognised. In order to test whether the organism was really a diatom, and had a silicified covering, we endeavoured to crush some specimens between two slides, and although the experiment was a difficult one on account of the small size of the filaments, and of the fact that the surfaces of the slides are not exactly plane, we satisfied ourselves that some of the cells were fractured, and not simply crushed as a vegetable tissue would be. It was evident from comparison of different filaments that each cell frequently divides into two, but we have not succeeded in seeing exactly how this takes place. In fact, there are many things about the organism that we find very puzzling. This much is certain, that the globes appear upon the thinnest filaments, from which it would seem that new cells are formed inside the old ones, and are therefore of less diameter; and so on from time to time, until a stage is reached when no further cell-division takes place. It appears that when the filaments have reached a certain stage of growth, the endochrome in some of the cells becomes green, but our observations have not enabled us to say definitely what then takes place.

Desmids are beautiful objects, but we have not come across very many except at Strathpeffer, where there were great numbers. Some of them were very large, and, except for their bright green colour, closely resembled ornamental dish-papers. Closteria, which belong to Desmidieæ, may be found anywhere: they are usually crescent-shaped, and often look like tiny cucumbers. I am afraid we have been rather lazy in regard to Desmids, for we have not identified a single one! We were for a long time anxious to find Volvox; but as we were unable to do so, we wrote to Mr Bolton, who advertises in 'Nature,' and obtained some specimens from him. The winter before last Mr Thomas Scott advised us to fish for it in the Elf Loch. We did so in faith, and when we examined our collection that evening we were delighted to see a large number of these lovely organisms. They are perhaps more fascinating to watch than any other microscopic object, owing to their graceful motion and exquisite structure. They seem to be very fragile, and our specimens disappeared entirely in two days, leaving, as Shakespeare says, "not a wrack behind." The

Pediastrum is a somewhat similar object, but not nearly so beautiful. We have since obtained Volvox from the pond in the Botanic Garden.

Among the most interesting Algæ which we have found are Spirogyra, Schizonema, Nostoc, Chætophora, Vaucheria, Batrachospermum, and Draparnaldia. Spirogyra is very common: as the name implies, the endochrome is arranged in graceful spirals in the cells. The number of turns in the cell, as well as the number of threads, vary according to the species. We have frequently found Spirogyra in conjugation, when it presents many curious features: two cells, for instance, may occasionally be seen both trying to reach the same cell in the opposite filament, and when this happens, one or the other will most likely be left out in the cold altogether.

We found a good deal of Nostoc at Strathpeffer, but have seen comparatively little about here. It is like chains of tiny green beads, and at one period these are coiled up in a mass of transparent jelly.

My mother brought us our first specimen of Schizonema from the roof of Craigmillar Castle (and who knows but its ancestors may have lived there in Queen Mary's time!). At one stage of its development it spreads out in broad curly fronds, easily recognised by the naked eye, but later on it divides into narrow filaments. These two stages were for some time thought by naturalists to be two distinct plants.

Chætophora endivæfolia grows pretty freely in Ravelston Quarry, and is a beautiful object. The filaments are enclosed in a gelatinous thallus very like a tiny endive leaf. In order to get a good view of the separate branches, we found it necessary to press a fragment pretty hard between two glass slides, and hardly too much pressure can be used when a view of the branchlets is wanted.

Vaucheria is a rather large bright-green alga, not divided into cells, but continuous throughout the filament, and is interesting chiefly on account of its curiously-shaped antheridia and sporangia: it can almost always be found growing in flower-pots inside any greenhouse.

We found both Batrachospermum moniliforme and a Draparnaldia in the New Forest: they are closely related, and in both the cells of the main stem are almost colourless, having only a slight trace of endochrome, while the thick clusters of branchlets are vivid green. We found another Batrachospermum at Grasmere, and Mr Craig-Christie and my brother found a third on the Pentlands, but we have not been able to identify them. These Batrachospermums are about the prettiest algæ we have seen.

Here ends the list of our chief treasures, and although they may be common and well-known objects, they have had all the charm of novelty for us. The study of microscopic life has opened up quite a new world to us, and has invested every pond and ditch with fresh interest. It is a doubly satisfactory hobby, as we can pursue it out of doors in making excursions to favourite haunts, and indoors in examining our finds at any leisure time. Its one drawback is its fatal power of fascination: it is often very hard to tear ourselves away from the microscope at bedtime! I hope we may have been able, in this short sketch, to give a few useful hints to any who are thinking of taking up this interesting study, and we shall be very glad to receive suggestions of any kind from those who know more about the subject than ourselves.

III.—*MICROSCOPY AND SOME OF ITS USES.*

By Mr WM. BLACKLOCK.

(*Read Dec. 22, 1897.*)

We may distinguish two courses in microscopic studies. They may be resorted to as a means of recreation and amusement, or for the entertainment of friends; and if one has the taste to select or the skill to prepare suitable slides and apparatus, there is an immense and interesting field open. Nor can it be said, if we admit that the contemplation of proportion, of harmony, and of beauty ranks among the highest educational agencies, that this is a profitless or frivolous course. The other course is that in which one takes to microscopy because one is dissatisfied with a mere stock of scientific phrases, and wants rather to have vivid impressions of scientific facts—because one has a desire to face the great problem of life and its relations. This course has the singular merit of being quite equal to the other from an æsthetic point of view in regard to the beauty of the objects contemplated, and furnishes besides an extremely grand and inexhaustible source of interest.

Many persons succeed fairly well in both these courses with but little previous scientific knowledge. But previous scientific knowledge is a great advantage, especially in the second course. Indeed every microscopist should know a little of the natural sciences, and at least as much of mathematics up to trigonometry as can be learned from the articles of an encyclopædia. This is absolutely necessary if one aspires to be an intelligent student. Opinions about microscopes and lenses are often unscientific, and even misleading, and much mixed up with the personal equation: it is therefore highly important that the student should be able, concurrently with the use of the microscope, to make a thorough study of its structure and of the properties of lenses, and to understand the function of angle or aperture in an objective, and generally to think and act for himself.

It is further desirable that the student should have or acquire some little mathematical knowledge to enable him to appreciate the theories of Professor Abbe, which are fully expounded in the second chapter of Carpenter, and which form the most considerable addition to modern microscopic science. Before Abbe's time the part aperture plays in an objective was not well understood. The first part of his theory put this matter on a scientific and clear basis. Agreeing that the rays of light from an object under the microscope take the form of a cone of which the front lens is the base, the vertical section of this cone gives an equal-sided triangle which measures the angle of the objective, and gives one of the factors. Remembering next that different media, such as glass, water, air, &c., refract light differently, and that comparison gives the index of refraction of a medium, we get the other factor, and the merit of Abbe's researches consisted in connecting these two factors—in showing that in all cases the numerical aperture, which is so seriously important in an objective, can be measured and stated by the product of the index of refraction into the sine of half the aforesaid angle.

Thus if we suppose the sides of this whole angle spread out until they coincide with the slide, we shall have a semicircle, or 180°: half of this is 90°, and the sine of 90° is 1; and taking 1 as the refractive index of the air in which the objective works, the product of these two ones is 1, and we get 1 as a maximum, and as a standard of comparison. Looking now at a descriptive table of objectives, we see at once that fractions such as ·70, ·80, ·90, are near the maximum, and are high apertures, that ·50 is half the maximum, and that ·20 is only a fifth of it, and is a small aperture. Since the performance of an objective depends both upon its angle and the refractive index of the medium between it and the object, this coupling of these two factors gives effect to a natural relationship, and explains why when the index is increased, as in immersion, the numerical aperture can be raised to values above 1.

The second contribution of Abbe, called his theory of diffraction, is more complicated, but, probably, still more important. It gives the scientific reason why objectives in virtue of high aperture come to have the marvellous quality of resolving very minute structures and details and making them visible. It can only be learned by private and repeated study, assisted by some previous knowledge of physical optics. As a simple illustration, suppose we place under the microscope a circular diatom, having an actual diameter of one-hundredth of an inch, and which, from previous observation with a wide-angled objective, we know has very fine lines or markings all round its centre. Look at it with an inch objective of low angle and magnifying, say, fifty diameters. The object has now the apparent size of half an inch; we see it perfectly in outline, but the central part is somewhat hazy, and there are no signs of the fine lines we know to be there. How is this? Is it not sufficiently magnified? Well, with a higher eyepiece magnify it a hundred times: it is now an inch in diameter, and still the fine lines do not appear. We must go back to the beginning and get the explanation from Abbe's theory.

In physical optics it is shown that when light passes through a very fine grating, or very fine lines ruled on glass, it does not, after emerging from the grating, continue to be propagated in straight lines. It spreads out sideways all round, and we have to think of it as radiating from every point on the emergent side of the grating in an infinitude of wide conical pencils. This diatom, then, with its fine symmetrical lines, like nearly all the objects looked at by microscopes, is comparable to a very fine grating, and light behaves similarly in passing through it. In the innumerable rays which radiate from this diatom we may, however, distinguish two kinds. There are first those which are but little bent from a straight path,—these go to form the outlines of things, and can be grasped by lenses of small angle. Then there are those which are very much bent or diffracted in all directions,—so much so that only part of them can be grasped by the widest-angled objectives,—and the experiments of Abbe show that it is these diffracted rays which chiefly image fine structures and details, and that unless an objective has sufficient width of angle to grasp a considerable portion of them it cannot have high resolving or defining power.

Like most discoveries, this is only a specific application of a general natural principle. In ordinary vision, if we were to think away all the infinitely small and irregular particles which make up a surface or a body, we should see nothing. It is because bodies are never perfectly smooth or perfectly uniform that they are visible. In fact, it is the infinitely small irregularities of a surface which, acting like prisms and lenses, reflecting, refracting, and diffracting light, form images, and constitute the details of all the forms we see. There is thus no escape from Abbe's theory, and the process of superposition of images is just like that of an artist first sketching the outlines and then filling in the details. Hence a microscopic image can only be true to nature when all the diffracted rays are included: until this can be accomplished we are only "seeing through a glass darkly"—the images are true so far as they go, but not the whole truth.

But though the general theory of diffraction is of very great importance, and while I have wished to accentuate the advantages of kindred scientific knowledge, I hope I have not left the impression that a person may not begin microscopic studies until he has mastered these rather difficult theories. This would be wrong. It has been truly said that in most scientific studies a rush is made to the advanced parts, and that it is only afterwards, and from a desire to be better grounded, that serious students turn back to learn thoroughly the fundamental principles. And so, perhaps, the greater part of those who take to microscopy just begin and learn these things as they go along, and in proportion as they desire to make their grasp of the subject deeper and wider.

Suppose a person has resolved to begin, he should go about the procuring of a microscope cautiously. If he buys a new one before he knows anything of the structure of microscopes or the merits of the various stands, he may find himself fixed to an unsuitable one. The reputation of a maker is not a good substitute for personal knowledge on the part of the purchaser; but he should get and study the catalogues of the principal makers, for, though there are errors and advertising phrases in them which need to be discounted, a great deal about microscopes and apparatus can be learned from them. There is still greater hazard in buying a second-hand one. I have attended many sales of microscopes. On very rare occasions I have seen good instruments go cheap. But the general feature is a turn out of old and shaky instruments, such as a judge would not have at any price, which bring far more than they are worth.

By far the best and cheapest way for a beginner is to hire an instrument for the first three or six months. This will cost about 3s. per month, which will be far more than saved by the greater judgment and economy with which he will be able to make his subsequent purchases. At the end of the three or six months he will have learned a good deal about the structure and working of a microscope and lenses, and may thus be able to form a useful opinion as to the particular kind of work he wishes to pursue, and the outfit suitable for it.

Every microscope should have sufficient space for the attachment of substage apparatus when required, and is all the better if it have a rack-and-pinion substage; but beginners should neither imagine that special illuminators are indispensable, nor let their expectations be excited by much that is said about illumination. Like the kindred matter of the performance of objectives, illumination is generally measured just as heat was measured before there were any thermometers, by sensation. It is mixed up with the personal equation. Statements about it need to be critically examined. When we give an opinion on illumination, or the performance of an objective, it should always be accompanied by a comparative estimate of the sensitiveness of our eye, and the several other factors in the process. A statement without this is of little value, and may be only misleading. I believe I shall justly epitomise opinion and experience on the subject if I say first, that for all ordinary work the simple mirror is quite sufficient; second, that in some cases the Abbe is useful; and third, that for special work achromatic illumination is certainly the best.

After we have made a certain progress in the use of the microscope, while the things we do see fill us with increasing wonder and satisfaction, there is also sometimes a little disappointment because of what we have failed to see. We do not at the outset see all the minute details mentioned and figured in the books, and perhaps we blame the lenses, or think we have not the necessary acuteness of observation. But we have to remember that, as in other sciences, these details were only reached by the accumulated efforts of many observers, and that some of them are only to be seen on rare and favourable occasions, and by the use of reagents and other helps.

Then the results in high-power work are different from what we expected. Our notion of definition, perhaps, was that things should be enclosed by perfectly straight lines and perfect circles and smooth curves, and here we find that there are no perfectly straight lines or perfect circles or smooth curves in nature: that these are only mathematical conceptions, that the outlines are irregular, and that there is in the works of nature an imperfection analogous to that in human art between the ideal and its embodiment. Some of the most beautiful diatoms, for instance, look best at a power of about 250; at 500, signs of irregularity in the markings begin to appear. But this is, in fact, the service wanted from high powers, namely, to make the ultimate structure of things sufficiently plain to be seen and understood: while all this extending of the relation between the ideal and its embodiment leads up to wider conceptions of the unity and community of things. We also learn that this thing we call beauty existed apparently for millions of years before there was a human eye to be delighted by it.

As to the kind of objects to be studied I need say little. Everything furnishes objects, and all kinds of objects possess interest and yield mental improvement. In order to reach the deepest interest and the most real knowledge of nature we should, as far as possible, collect and prepare the objects with our own hands. Personally, I like those objects best which illustrate physiology, botanical and human, or which lead up to a fuller knowledge of biology—a science which towers above and utilises all the rest. In this way we see that microscopic science, as by far the greatest aid to biology, eminently tends to hunt dirt and disease and premature death out of the world, to lift sanitation above the level of human enactments and penalties and make good living voluntary, and, by the general relief of human misery, to make the world as good and happy a place as may be.

In order to make a general estimate of the uses of the microscope, we have only to remember that the changed and improved educational method of the last thirty years was chiefly initiated and formulated by an enthusiastic microscopist of great courage and literary power—by Huxley. But we are only beginning to see the need of making the change more thorough and extensive. We still need to draw the distinction more strongly between learning and education. A man may be educated without being learned, and he may be learned without being educated. The blunders of history, the rejections of discoveries and discoverers, have been mostly committed by learned, and often highly learned, men. Our education still needs to be far less a thing of books and far more a thing of facts about the universe in which we live. Instead of being educated, our minds have been so dissipated by this over-reliance on books that there is often no meaning behind what we read. The Greeks were surely an educated people, and if so, it was chiefly due to contact with natural objects, and but little to books. Therefore, in bringing us back more and more to the study of natural objects—to a real education—the usefulness of the microscope can scarcely be exaggerated.

As recent instances of microscopic achievement, those interested should read the review in 'Science Progress' for May 1897 of Dr Kleb's work on "The Physiology of Reproduction in Plants," and the article on "Recent Science" in the 'Nineteenth Century' for July 1897, in both of which new and extremely interesting results are given. In the latter of the two there is an account of a very brilliant discovery in brain structure, which goes a long way towards explaining the action of the brain both in health and disease. It is true, not many have the means or the ability and devotedness required for the highest researches. But there is a splendid field for thousands of humbler workers to gather around the leaders in research, to cheer them on, to co-operate with them by appreciating their work and scattering the fruit of it far and wide. We have arrived at a time when we suffer not so much from the want of new discoveries as from the slow rate at which already discovered truths are utilised. Hence, I believe, there are few ways in which we can do more real good than by trying to make it the desire of every household to possess a good microscope, and to study the sciences and the ethics which circle around it. For while there are many ways of slightly alleviating human misery, all the ways of thorough amelioration resolve themselves into scientific knowledge of life and the conditions of its wellbeing, such as the microscope is eminently fitted to give.

IV.—*CORALS AND CORAL-ISLANDS, WITH SPECIAL REFERENCE TO THE NEW HEBRIDES GROUP.*

By the Rev. J. H. LAWRIE.

(*Read Jan. 26, 1898.*)

The New Hebrides group of islands extends to about 400 miles in length — lying N.N.W. and S.S.E., between 21° and 15° south latitude, and 171° and 166° east longitude. Aneityum, the most southerly island of the group, lies about 1000 miles due north of New Zealand, 400 miles east of Fiji, and 200 miles east of New Caledonia. The first European navigator who discovered the largest and most northerly island of the group in the year 1606 was Pedro Vernandes de Quiros, a native of Portugal. That island is still known by the name he gave it of "Espirito Santo." Quiros, elated with his supposed discovery of the great southern continent, returned home at once, instead of prosecuting his inquiries further. In a series of most wonderful statements, he presented his memoirs to King Philip III. of Spain, pleading the urgency of sending out another expedition to open up the wealth of the country. When we state that the island of Santo is only 70 miles long by 40 miles broad at its widest part, the ridiculousness of Quiros's report will be apparent. "Your Majesty," said he, "may be assured that the extent of these countries exceeds that of Europe, Asia Minor, the Caspian Sea, and Persia, together with the islands of the Mediterranean and Atlantic, including England and Ireland."

Although there are few song-birds in the country, Quiros spoke of millions of birds announcing the rising sun, and of gold, silver, and pearls being found in abundance. Later inquiries have found pearl-shells in the sea, but neither gold nor silver has been discovered on land. Quiros must have had the missionary instinct, as he set up a wooden cross and called the place where he anchored his ship the harbour of "Vera Cruz," or the true cross. He also named a river running into it the Jordan, intending to found a city to be called the New Jerusalem. He met with but poor success, however, at the Spanish Court, and a few years afterwards he died—disheartened and disappointed.

The French navigator, Bougainville, was the next to visit Santo and the neighbouring island of Malekula; but the greatest honour was reserved for our own Captain James Cook, who in the year 1774 spent forty-six days in the group, and discovered the other islands, some thirty in all. When these were set down on his chart, he saw, or fancied he saw, a resemblance to the islands on the west coast of Scotland, and accordingly felt himself entitled to give the group its present name—"The New Hebrides."

For the most part these islands are of volcanic origin: there are many indications of burnt-out craters; and large active volcanoes still exist on Tanna, Ambrim, and Lopevi. The flare in the sky from the Tanna volcano can be seen some sixty miles off, like a great lighthouse. Since Captain Cook's day, and probably from long before that time, the explosions have taken place without intermission every four or five minutes, the steam being generated from a lake of water a short distance away from the mouth of the crater. Some twelve years ago, along with a party, I ascended the volcanic cone on the weather side, and approaching as near the edge as possible in the intervals between the explosions, we saw the molten lava at a depth of five or six hundred feet, like the molten metal from a great blast-furnace. From side to side the crater would be a rifle-shot across. There were five vents, and when the explosions took place hundreds of tons of scoriæ were sent high into the air with a fearful roar and rumbling underground noise, fit to strike terror into the stoutest heart. The sulphur fumes are very strong and almost suffocating on the mountain-sides, proceeding from fissures here and there at irregular intervals. Many shiploads of sulphur have been taken away from a large deposit near the sea-shore. Earthquakes are of common occurrence in this region, and are sometimes accompanied by a tidal wave which carries all before it with irresistible force. After one such wave we noticed marks on the trees near the sea-shore seven feet from the ground. Quantities of dead fish and *débris* of every kind were left on our mission station, to be cleared away next morning.

Great masses of coral abound in these tropical seas, but islands of the atoll type are not common in the New Hebrides. The fringing reef, from the shore seawards and terminating in deep water, is common to all the group. On some islands, such as Aneityum, a small barrier reef exists on the south-west and north-east sides, whereas on the weather side, where the south-east trade-winds blow, the coast is bold, with the mountain ridges terminating in deep water. These barrier reefs are from one to two miles from the shore or inner reef, and the intervening space makes an excellent and safe fishing-ground for the natives. Owing to subterranean activity, there is abundant evidence of both elevation and depression. On the island of Tanna there was a great earthquake on the 10th January 1878, which caused a surge of the water at Port Resolution to rise forty feet, and to sweep everything before it, destroying all the canoes of the natives. Two minutes after the earthquake a rise of the land took place on the whole west side of the harbour, to the extent of about twenty feet. This narrowed considerably the effective anchorage of the harbour, and a lost anchor came into view where a ship had ridden safely some years previously. About a month afterwards another earthquake caused a further elevation, so that rocks which were formerly covered with seven or eight fathoms of water are now above high-water mark. On Aniwa, and especially on Futuna, there are distinct evidences of successive upheavals, solid coral rocks being seen at a considerable height in the mountain-side.

The marvellous beauty of the growing coral when under water must be seen to be understood. When, from a canoe or rowing-boat, one looks through the clear blue water upon patches of brain coral, branching coral, and other corals of every description, it seems a fairy castle in the depths of the sea. The branching coral, with delicately mauve-tipped points, is like a vast array of stag's antlers. On the deep caverns among the coral masses may be seen multitudes of bright-hued fishes, some blue, others red, yellow, and grey, striped and spotted, and of all curious shapes. Lurking in the nooks and corners may be seen the cowrie, the turbo, or the large edible clam, or, it may be, the sea-urchin with its blunt red spines, or the bright-blue starfish with its finger-like arms spread out.

Outside the barrier reef the long ocean swell rolls in, wave after wave, each gradually rearing its crest higher and higher, until it curls over, and falls like an avalanche of white foam, with a thunderous roar, upon the flat coral-reef. The native oarsmen take a special delight in steering as near to the breakers as possible: they know exactly how near they may venture with safety. But woe betide the canoe that is carried by the swell broadside on in one of these huge breakers! The canoe and its occupants are rolled over and over, until they are at last dashed with terrific force against the sharp points of the outer reef.

To what depths the solid coral-reefs may go is not yet known; but the first thing that raised in Darwin's mind the suspicion that these coral-islands are sinking into the ocean-bed was the deep soundings he obtained quite near the outside of the coral rim in some of the atolls he visited. In his study of the subject, Darwin started the theory that "the original coral-reef gradually subsided, and the coral polyp, which is unable to live at more than a certain depth below the water, is kept perpetually rebuilding on the surface." Dr John Murray, on the other hand, asserted that "the ocean-floor has risen owing to the heaping up of the remains of marine organisms, and the coral-builders have lived and worked on these elevated banks." In order to test the truth of Darwin's theory, an exploring party was organised some few years ago by the Royal Society of London. After they had made some inconclusive observations, an expedition was despatched from Sydney, consisting of Professor T. E. David of Sydney University, Mr George Sweet, Fellow of the Geological Society, and six trained diamond-drillers. The party left Sydney in June 1897, and ultimately chose for their purpose the island of Funa Futi, in the Ellice group, lying 600 miles due north of Fiji. The island is from ten to fourteen miles in diameter, and is well supplied with cocoa-nut trees, which furnish the inhabitants with their main food-supply. As soon as the party landed they were lodged in bungalows in the native village, on the inner rim of the coral-reef. They at once proceeded to transport the diamond-drill plant and scientific instruments to a convenient spot near the outer edge of the reef, and a suitable site was found for commencing drilling operations. With 100 tons of coal to keep the boilers going, the diamond-drill men started on their arduous task, and got down 200 feet without leaving the coral *in situ*, through what they call "the toughest material they had ever tackled." Boring was continued, however, until in December 1897 it was reported that a depth of 700 feet had been reached, the drill being still in solid coral, and there could be no reasonable doubt that the substance had subsided from the surface, and that fresh accretions by the indefatigable coral-worker had continually renewed the top of the reef by what Darwin called "a renovating agency." Seeing that the coral-builders' life-zone is only from 120 to 150 feet below sea-level, and that, in spite of frequent breakages, the drillers got to the depth above stated, it is evident that the theory regarding coral-islands formulated by Darwin over fifty years ago has been established by these recent experiments.

Professor Dana states that "there are 290 larger coral-islands in the Pacific Ocean, representing an area of 20,000 square miles." In addition, these tiny architects have built up a barrier reef along the shores of New Caledonia for a length of 400 miles, and another barrier reef which runs along the north-east coast of Australia, 1000 miles in extent. These vast edifices of the coral polyp have been raised in the midst of the ocean waves, and in defiance of the tempests which so rapidly annihilate the strongest works of man. Allowing for the operation of "a renovating agency" on the top of the reef, there must have been a series of gradual subsidences of the rocky basis from the shore seawards, carrying the fringing reef downwards to enormous depths. Who from this can conceive the antiquity of the globe we now inhabit, or the countless ages that have passed since the atoms of which it is formed were first brought together by a Divine Creator?

In geological formation the south end of the New Hebrides and the north end of New Zealand bear a striking resemblance, so that it is possible the one may at some time have been a continuation of the other. In both regions the climate, as far south as Auckland, is humid, modified by the sea-breezes. In both cases numerous streams descend from the mountain-sides, producing a profusion of undergrowth only seen in moist regions. New Zealand is noted for its ferns, and so is Aneityum, the magnificence and variety of these being marvellous. A professional botanist who explored the south end of the New Hebrides stated that he found 120 different kinds of ferns on Aneityum, in addition to crotons, dracænas, hibiscus, and other decorative plants. A variety of the far-famed Kauri pine of New Zealand grows in abundance on the hillsides of Aneityum. Of quadrupeds, the only indigenous animal found in New Zealand was a small dun-coloured rat: this also was the case in the New Hebrides. Pigs were found on some of the islands by the early navigators, but these are supposed to have been imported. Horses and sheep have been tried, but the humid atmosphere does not seem to suit these animals, for they do not thrive. Pigs, goats, and cows appear to do well. The pig is held in great estimation by the native population. It is used on the heathen islands for the purpose of appeasing the gods and the rain-makers. At all public ceremonies numbers of pigs, young and old, are always in evidence. A man rises in the scale of chieftainship on Malekula in proportion to the number of full-sized pigs he presents at the public feasts. Wives are also purchased with this animal, ten tusked pigs being the price of a princess.

The problem as to the early occupation of these islands still remains unsolved. The many languages spoken by the natives on the several islands, the various styles of dress, the diverse shapes of weapons, and the different heathen customs, all lead one to suppose that they did not all come from a common centre at the same time, although it is admitted that the native inhabitants are of the Negrillo type, the majority having the Papuan cast of countenance. On some islands, such as Futuna and Fila, there is an admixture of Malayan blood from Eastern Polynesia. This can be accounted for by fishing or trading parties being blown out to sea, and then driven before the south-east trade-winds until they reached one or other of the New Hebrides Islands. If the islands have always remained as they are, then the progenitors of the present inhabitants must have found their way thither by means of navigation. If, on the other hand, a great subsidence has taken place in that portion of the Pacific, obliterating a continent and leaving the mountain-tops to form islands, then naturally the strongest would seek to save themselves by taking refuge in the higher regions, and the fittest would survive. As matters are at present, long years of isolation have done much to intensify the differences in language found on most of the islands in the New Hebrides group. These are not mere dialects, but languages as distinct from one another as English is from French, or that from German. In some of the larger islands, such as Tanna, Epi, Malekula, and Santo, from two to six languages are spoken. The tribes, moreover, have little intercourse with each other, national jealousies and hatreds continuing from one generation to another, as in the case of Tanna, where tribal war is the rule rather than the exception. These differences in language may be illustrated by giving the names for the sun and moon on some of the islands :—

Island.	Sun.	Moon.
Aneityum	Nangesega	Inmohog.
Tanna	Meri	Makua.
Futuna	Tara	Tamrama.
Eromanga	Nipminen	Itais.
Efaté	Elo	Atelag.
Epi	Maregio	Simberio.
Ambrim	Yal	Ol.
Malekula	Niar	Nebur.
Santo	Metanalo	Wula.

A further philological study of the many languages spoken by the natives, and a fuller inquiry into the folk-lore and legendary stories of the older people, may lead to some clue as to their original abode, and the means by which these New Hebrideans have been distributed over so wide an area in the South Pacific Ocean.

V.—*ADDITIONAL NOTES ON THE GREAT AUK OR GAREFOWL* (ALCA IMPENNIS LINN.),

WITH SPECIAL REFERENCE TO TWO NEWLY RECORDED SKINS.

BY MR SYMINGTON GRIEVE.

(*Read Feb. 23, 1898.*)

I HAVE written this paper so that it may appear in the same volume of the 'Transactions' as my paper upon this subject that was published last year. The information which appeared in that paper was from my notes written up to 31st July 1897, but since that date some other information worth recording has come to hand.

During last August I received from Mons. H. Duchaussoy of Amiens a valuable paper, "Le Grand Pingouin du Musée d'Histoire Naturelle d'Amiens," published in the 'Mémoires de la Société Linnéenne du Nord de la France' (tome ix., 1892-95). When this communication reached me, my paper was already in print; but through the kindness of the Editor of the 'Transactions' I was able to insert an acknowledgment of the receipt of Mons. H. Duchaussoy's pamphlet, which appears at p. 245. When I had time to peruse this contribution to Great Auk literature more carefully, I found it contains much information about French specimens of great interest and value, and contained the record of one skin which until now had been unknown. It has been discovered at Nielles-les-Ardres, and I give a translation of what Mons. H. Duchaussoy says.

SKINS.

France.

Nielles-les-Ardres.—M. le Baron de Vilmarest has in the museum at his château a most valuable collection of birds. The most valuable specimen of all is a magnificent *Alca impennis*, which was bequeathed to him by M. de Cossette in

1858. It was received by him in 1832 from Brandt, the naturalist of Hamburg, who said it had been procured in Greenland. According to M. Ch. Van Kempen, M. de Cossette was aided in acquiring this specimen for his collection by M. Delahaye of Amiens.

Autun.—The skin of *Alca impennis*, which was at Chalon-sur-Saône, and belonged to M. le Dr B. F. de Montessus, was, along with the collection of that gentleman, removed to Autun in 1895, and presented to the town, to the museum of which it forms a magnificent addition.

Great Britain.

Edinburgh Museum of Science and Art.—I refer to this specimen at p. 248 of this volume, and received information that it had been purchased for the Museum at the price at which it was bought in at the sale-rooms of Mr J. C. Stevens, King Street, Covent Garden, London, which, according to press notices of 24th April 1895, was 350 guineas. I am informed by Dr R. H. Traquair, F.R.S., that the price was £350, not guineas. He has also reminded me of his note upon "Remains of the Great Auk in the Edinburgh Museum," which appears at pp. 196, 197, 'Annals of Scottish Natural History' for 1895, in which he states the price. I read this note at the time of publication; but, unfortunately, not having a separate copy to place beside my Great Auk papers, it had escaped my memory.

Tring, Herts: Boucard-Field skin.—It seems probable that this specimen is the one that belonged to M. Ernest Delegorgue's collection. Hearing that the Delegorgue specimen was amissing, I wrote to Mons. H. Duchaussoy requesting him to favour me with such information as he could obtain upon the subject, as the skin had not hitherto been recorded, and might be the skin figured at p. 269, Plate III. I give at pp. 248, 249 its history so far as known to me at that time. Since then I have been informed by Dr Hartert (see letter of 21st September 1897) of the Tring Museum that it was bought in Paris by M. Boucard, who declined to say from whom he had obtained it, as he had promised not to do so.

On 28th December 1897 Mons. H. Duchaussoy kindly replied to my inquiries as follows: "I have the honour of sending you some new information regarding the Great Auk which formed part of M. Ernest Delegorgue's collection. This collection, which was in bad condition, was on the death of M. Delegorgue given to the town of Abbeville, with the exception of two interesting specimens—the Snow Harfang (Great Snowy Owl) and the Great Auk, which was kept by M. Jules Barbieux, now dead. His son-in-law, M. Paul Holtzapffel, judge of the civil tribunal, Rue de la Tannerie, has kindly written an interesting letter to me, from which I extract for you the following passage: "The following entry has been found in the books of my father-in-law under the date July 17, 1888, 'Received from M. Maingonnat for a bird, 1000 francs.' It is certainly the *Alca impennis* of Delegorgue which was sold for 1000 francs to M. Maingonnat." [1]

As I was anxious to find out when Mr Leopold Field bought the skin now belonging to the Hon. W. Rothschild, I wrote him requesting some information, and he kindly replied on 6th January 1898: "The skin was offered to me, I think, in the early summer of 1890. Mons. Boucard said it was a different skin to the one he first offered by letter at £1000.[2] Finally he came down to £300 (three hundred pounds), which I gave. The whole transaction and correspondence did not occupy a month. The final date would be June or July 1890. I paid £300 net cash, delivered at my rooms, and in 1893 sold it and the Potts egg to Mr Rowland Ward, Piccadilly, for £630. The specimen came unmounted, with little spikes in the feet. I had it handsomely displayed in a glass case, with a model egg and a background of sea and sky. Mr Rowland Ward had all the papers relative to the skin and egg."

This skin was removed from its case and sent by Mr L.

[1] Mons. H. Duchaussoy, in his "Notes Additionelles," published in 1898, in a note to p. 8, says that M. Maingonnat, who resided at 37 Rue Richer, Paris, died in 1893, and that his business of merchant of natural history wares has not been continued.

[2] The skin for which Mons. Boucard wanted £1000 is presumably the skin now in the collection of the Hon. W. Rothschild, which he bought from Mons. Boucard, and which came from the collection of Count David de Riocour, Vitry-le-François.

Field on approbation to the Museum of Science and Art, Edinburgh, where it remained some time, and where I had the pleasure of seeing it, through the kindness of Dr R. H. Traquair, F.R.S. It had rather a dilapidated appearance, the plumage dirty, and the webbed part of the feet somewhat worm-eaten, and the spikes or wires for attaching it to its stand, referred to by Mr L. Field in his aforegoing letter, were projecting from its feet.

When purchased by Mr Rowland Ward, he had the skin cleaned, re-stuffed, and mounted on a new stand, and I am told that the work has been done very skilfully, as one may judge by the appearance of the specimen from Plate III., p. 269.

France.

Paris.—M. H. Duchaussoy, writing me on 23rd July 1897, informs me that the collection of M. Jules Vian, Rue de Petits Champs 42, Paris, is kept at Bellevue, Seine-et-Oise. This statement M. H. Duchaussoy has since modified in his paper published this year, "Notes Additionelles," as he has discovered that although M. Jules Vian keeps his collection of European birds at Bellevue, he retains the specimen of *Alca impennis* Linn. and his collection of eggs in his house in Paris.

Have Great Auk skins been stretched too much in skinning? —Mr Frederic A. Lucas, Osteologist of the Smithsonian Museum, Washington, U.S.A., and who has been working in connection with the Alaskan Fur-Seal Commission for the past two years, writes me as follows on 7th November 1897, referring to my paper at p. 237 *et seq.:* "Your figures of the immature specimens are very interesting, and I am glad to see them. As usual, all the specimens are much too long. I fancy that the neck of the Great Auk was very much like that of the fur-seal, in that the skin stretched very much when taken off. I am curious to see if our taxidermist will be able to keep the male fur-seals down to their proper length."

Was the chick of Alca impennis *covered with down when hatched?*—I am not aware that this question has been considered by any writer upon the Great Auk, nor do I know of any reference to this particular period in the life-history of *Alca impennis.* If we turn to the allied species, *Alca torda*, we may perhaps get a hint as to what was the state of the young of *Alca impennis* when introduced into the world.

In an article which appeared in the 'Zoologist' for April 1894, p. 123, written by Mr John Cordeaux, reviewing the popular brochure by Professor Robert Collett of Christiania, entitled 'Bird Life in Arctic Norway,' the writer says: "The young Razorbill (*Alca torda*) ushered into the world on a bare wind-swept ledge exposed to every storm, to sleet, snow, and rain, is almost entirely naked; but the young Puffin, born in a deep and sheltered hole, is a living ball of down. The apparent unfitness of this arrangement is one of those points in the economy of nature difficult to understand, for it does not appear in this case, at least, that the wind is tempered for the shorn lamb."

Bones.

Ireland.

Professor A. Newton having kindly informed me that a discovery of bones of the Great Auk had been made in one or more ancient kitchen-middens on the coast of County Waterford by Mr R. I. Ussher, I wrote that gentleman, and in reply he referred me to a short article he had written which appeared in the 'Irish Naturalist' for August 1897. In that article he says: "I recently sent to Professor Newton some birds' bones, found by me in kitchen-middens on the coast of this county, from which I have also obtained bones or horns of ox, goat, horse, pig, red-deer, and domestic fowl, an abundance of shells of oysters, cockles, mussels, and limpets, with many pot-boilers or burned stones. I have just received back the birds' bones from Professor Newton, who kindly writes as follows:—

Cambridge, *8th June* 1897.

I think that all but two of them are fairly determined, thanks to the care bestowed on them by Dr Gadow. The real work of determination was done by him, though I have gone over it for my own satisfaction. I congratulate you on possessing remains of at least two Great Auks, for you will notice that the two coracoids are of the same side. I hope you will duly record the occurrence of *Alca impennis.* Read in the light of these relics, Mr Davis's famous bird of 1834 must have been visiting the home of his forefathers.

"On the 14th June, accompanied by Mr Percy Manning, I revisited the kitchen-middens, and we picked up some additional birds' bones, which I submitted to Dr Gadow, who again kindly determined them. They contained a humerus, tibia, and metatarsus of Great Auk."

Northern Ireland.—Mr W. J. Knowles of Ballymena, writing me on 3rd November 1897, says: "I think it was since I wrote you last that I was requested to show the bones in my possession to Professor Newton of Magdalene College, Cambridge. I sent them as requested, and he confirmed previous reports both regarding identification and the probable number of individuals represented by the bones in question. In one case I had found a humerus partially bared and the other smaller bones closely connected. These latter, with the humerus, I kept together, and they were found to be ulna, radius, metacarpus, and phalanges—in fact, the whole bones of one wing. These I am still keeping in a small box by themselves. From becoming acquainted in this way with the appearance of an ulna, I have since found another ulna among some other bones."

Mr W. J. Knowles, writing me on 22nd March 1898, says: "I was down for two days at Whitepark Bay, and obtained the following bones of the Great Auk—broken humerus, two coracoids, one scapula. Except the humerus, all are in good and perfect condition. I also found lately among the bones I formerly obtained from Whitepark Bay a tibia of the Great Auk."

Mr W. J. Knowles, in answer to my inquiries, again wrote me on 30th May 1898: "The hut sites at Whitepark Bay are situated on the top of a bank of sand close to the sea, about 30 feet above high-water mark. I suppose there are twenty to thirty hut sites in all. It was by digging in the old surface, which is distinguished by its blackness and shells, broken bones and flint, that I got the first bones of the Greak Auk.

Afterwards I got two humeri which had weathered out of this old surface. Then the humerus with ulna, radius, and smaller bones of the wing were found where they had all just freshly dropped out, and were still in close relationship to each other. All of these were found opposite different hut sites, and those I wrote you lastly about were found opposite a hut site where I had not previously obtained any such bones. The two coracoids I got a few days ago belong to one side, and so, though found near each other, could not be a pair. All the bones, however, have been found at Whitepark Bay within a radius of 200 or 300 yards."

These discoveries of Great Auk remains in kitchen-middens are exceedingly interesting, as they indicate pretty clearly that the few Great Auks that are recorded as having been seen along the coasts of Ireland during the past century were visiting the homes of their progenitors.

It seems likely that further investigations will lead to the discovery that the Great Auk did not confine its visits to only one or two points on the coasts of Ireland, Scotland, and north-eastern England, but was widely distributed, and formed an important item of food for the ancient fishermen and shore-dwellers of Ireland and the western and northern shores of Britain. I would even go further and suggest that the shores of Eastern Scotland and the north-east of England are well worth careful examination wherever the kitchen-middens of the ancient inhabitants are to be found.

In Scotland the remains of *Alca impennis* were found by me on Oronsay associated with the shells of many molluscs, fish-bones, and layers of scales of the grey mullet and other fish, numbers of bones of birds and animals, stone pot-boilers, stone limpet-hammers, bone spear-heads, rubbed bones or portions of antlers, a bone awl, and a number of other things enumerated at p. 47 of 'The Great Auk or Garefowl: Its History, Archæology, and Remains.' The race that formed this deposit appears to have been the same that left traces of its existence at various points upon the Irish coasts, and also in caves at Oban ('Proceedings of the Society of Antiquaries of Scotland,' vol. xxix., pp. 211 and 410). They may be the same people who formed the kitchen-midden at Keiss, in Caithness, in which were discovered by the late Mr Samuel

Laing remains of the Great Auk. The only bone of the Great Auk as yet found in England was discovered in a cave at Whitburn Lizards, County Durham. Both of these discoveries are referred to in 'The Great Auk or Garefowl: Its History, Archæology, and Remains,' pp. 43 and 62.

On 16th June 1898, when in London, I heard from Mr E. Bidwell, who had just returned from Copenhagen (where he had been having the egg of *Alca impennis* in the Royal University Zoological Museum photographed), that Herr Herluf Winge, Vice-Inspector of the Museum, had in his possession some recently discovered remains of *Alca impennis* Linn. from ancient Danish kitchen-middens, and that he might also be able to give me some other information regarding the Great Auk. I wrote Herr Herluf Winge, who kindly sent me the information I requested in a letter dated 2nd July 1898.

Meilgaard.—From the celebrated kitchen-midden of the ancient inhabitants at this place, additional remains of *Alca impennis* have been discovered, besides those mentioned by me at pp. 31, 33, 40, 84, and App., p. 58, 'Great Auk or Garefowl.' It appears that a valuable paper was published at Copenhagen in 1889, entitled, "Dyrelevninger fra Ældre og Yngre Stenalders Bopladser bestemte af C. G. Joh. Petersen, Herluf Winge, og Oluf Winge," which may be rendered in English, "Animal remains from dwellings of the earlier and later Stone Age determined by C. G. Joh. Petersen, Herluf Winge, and Oluf Winge." At p. 5 they refer to the remains discovered at Meilgaard that belong to *Alca impennis.* They say—"*Belonging to old birds:* A brain-case, part of a coracoid bone, two imperfect humeri (right and left, but not a pair), a femur wanting the upper part. *Belonging to the young bird:* A small piece of a scapula, a nearly whole humerus,—bones of full size, but with the surface not quite developed."

In his letter to me before mentioned, Herr Herluf Winge says: "From the well-known kitchen-midden of Meilgaard various bones have been brought to light by the excavations conducted of late years by our Museum of Northern Antiquities; they have been determined by my late brother Oluf. . . . They were of at least three individuals, two old and one young one; among other specimens there is a brain-case in excellent condition." Then Herr Herluf Winge continues, referring to other discoveries: "I myself, partaking in the excavations of still later years, have found the following specimens, all of them in kitchen-middens of the Stone Age:—

Sejrö, a small island to the north-west of Zeeland, the lower parts of two right humeri.

Havnö, on the northern shore of the Mariager Fjord (formerly an island), two right humeri and one ulna, as mentioned at p. 61, 'Fuglene ved de danske, Fyr 1, 1894.'

Ertebölle, on the shore of the Limfjord, south of Lögstör, the lower part of a left humerus.

I am just engaged in a review of the large mass of bones from kitchen-middens brought together by the late Prof. Steenstrup, but hitherto mostly undetermined. Bones of the Great Auk are turning up there, so that it will be useless now to give a list of the specimens from the old finding-places."

In the paper I have referred to by C. G. Joh. Petersen, Herluf Winge, and Oluf Winge on the "Animal Remains from dwellings of the earlier and later Stone Age," they refer the deposits in the kitchen-midden at Meilgaard to the earlier Stone Age, so we may naturally expect to find remains of *Alca impennis* Linn. being discovered in the kitchen-middens of later date.

Mould or cast of egg of Alca impennis *Linn. found in a geological deposit.*—Having heard from Mr Bidwell on 16th June 1898 that Herr Herluf Winge had mentioned to him that a hollow cast or mould of an egg of *Alca impennis* Linn. had been found in a geological deposit, I asked Herr Herluf Winge kindly to send me particulars. If such a discovery has been made, it is, I believe, the first time any remains of the Great Auk have been discovered in a geological deposit, and must take back the existence of the Great Auk to a much earlier period than most of those interested in the bird supposed.

Herr Herluf Winge wrote me on 2nd July 1898 as follows: "A hollow cast of an egg of the Great Auk, containing some colour-markings, was found in a deposit from the sub-glacial period in the southern part of Sweden, to the north-east of Falsterbo, by members of the Swedish Geological Survey. Through personal acquaintance the discovery was made known in Copenhagen, and the cast was determined by

Prof. Steenstrup really to be that of an egg of the Great Auk. I think the Swedes themselves have published something about it, but I do not know where. A preliminary report, a communication from the Swedish geologist Dr Holst, was published by Dr G. Hartlaub in 'Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen,' Bd. xiv., Heft 1, 1896 (the note in question perhaps only to be found in 'Zweite Ausgabe, als Manuskript gedruckt')."

Eggs.

British Isles.

London.—The late Lord Garvagh's collection. At p. 106, 'The Great Auk or Garefowl,' I referred to the broken egg that was in this collection, and remarked that it was probably still in the possession of the Dowager Lady Garvagh. At the time I wrote (1885) I was under the impression, from information received from the late Mr R. Champley, that the Troughton egg had been sold by the executors of the late Lord Garvagh to the late Mr G. D. Rowley, whose collection is now in the possession of Mr G. Fydell Rowley. Mr Champley had examined the Rowley collection, and had also a figure of the Troughton egg sent him by Dr Troughton from Coventry, 8th February 1861. However, Mr Champley seems to have been mistaken in his opinion, as Mr E. Bidwell informed me on 12th June 1888 that the egg that had gone amissing was that which belonged to Dr Troughton. This statement seems to be confirmed by the following notice, which appeared in the letter of the London correspondent of the 'Scotsman,' 22nd April 1898:—

Great interest was excited this evening at the meeting of the British Ornithologists' Club over the exhibition of a remarkably fine specimen of the egg of the Great Auk, which had been lost sight of for more than five-and-twenty years. The egg has a somewhat singular history. It was sold in 1842 by the late Mr A. D. Bartlett to a Mr Maunde for £2. Ten years later the specimen changed hands for £5, and in 1869 it was acquired for £60 [according to the late Mr R. Champley, should be £64[1]] by the

[1] Mr Henry Stevens writes me on 20th July 1898: "I have made an unsuccessful hunt for the sale books of the late Dr Troughton's sale. Mr Bidwell has, I believe, the late Mr Bond's catalogue, in which he entered the price at the time

second Lord Garvagh at the sale of Dr N. Troughton's collection. After the death of Lord Garvagh in 1871 the egg was reported to have been broken in pieces through the carelessness of a servant, but, as it turns out, was merely cracked, and having been put aside by the widowed Lady Garvagh, was lost sight of until a few days ago, when it was discovered among the personal effects of her daughter by Mr J. E. Harting, the Secretary of the Linnean Society, when examining the remnants of Lord Garvagh's natural history collection, long forgotten and stowed away in a dusty attic. The identity of the egg has been established beyond a doubt, the present owner being Mr Noble, by whom it was exhibited to-night.

On 16th June 1898 I had a conversation with Mr E. Bidwell in London, and he confirmed the identification of the egg, and stated that some years ago he saw a note in the handwriting of the late Mr G. D. Rowley, dated 1875, in which Mr Rowley stated that at that time the Great Auk's egg that belonged to Dr Troughton was amissing.

It is exceedingly interesting that this egg has been rediscovered. I had not lost hope that the damaged egg in the late Lord Garvagh's collection would yet be found, and continued to count it in my list of eggs as one of the doubtful lost eggs, that it might not be forgotten. It is now pleasing to be able to record it as undoubtedly existing.

France.

In his valuable paper entitled "Le Grand Pingouin," &c., M. H. Duchaussoy refers to the eggs in the Museum at Angers and at Eu, the latter having been formerly in the collection of M. Josse Hardy at Dieppe.

Angers.—According to Prof. W. Blasius (see p. 25, App., 'The Great Auk or Garefowl'), this is one of four eggs which were seen at Brest in 1859 joined on a string—probably brought by seamen from Newfoundland. M. H. Duchaussoy adds that M. Bouvet, Directeur of the Museum of Angers, has kindly given him some additional information. The egg, which is imperfect, has been roughly restored, the thick end having been replaced with mastic. The shell, without being smooth, is not rough to the touch; the colour is a dirty white,

of sale." I wrote Mr E. Bidwell asking him kindly to inform me the price noted in the Bond catalogue. He answered my inquiry on 19th August 1898: "I cannot find the catalogue. I have, however, a memo. in my copy of your book to the effect that Mr Bond's marked catalogue says £60."

with irregular dark blotches. The great axis is 128 mm., and the small axis 70 mm.

Eu.—M. H. Duchaussoy says: "M. Josse Hardy was born at Bacqueville, in the Pays de Caux, in 1798, and died at Dieppe on 31st December 1863,[1] after having given to the Museum of the town a magnificent collection of birds, containing notably a very fine specimen of *Alca impennis.* M. J. Hardy had also brought together a large number of eggs, which had been carefully named. The eggs were deposited in the Museum of Dieppe, to remain the property of his heirs.

"M. Michel Hardy and Madame Le Bœuf had them removed in 1895 to Eu, to the house of relatives of Madame Ursel, the granddaughter of M. Josse Hardy. According to a printed catalogue, the collection contained 1836 eggs, belonging to 388 species, some of which did not belong to Europe. We have noticed that some of the eggs were collected on the Ural Mountains and on the shores of Lake Baikal by Professor Martin of the University of Ekaterinburg. Many of the series are very interesting, from the number of varieties; for example, *Uria lomvia* (60), *Alca torda* (26), *Buteo vulgaris* (23), *Sterna Wilsonii* (22), *Larus argentatus* (22), &c.

"The most important egg is that of *Alca impennis,* seen in 1847 by Wolley and in 1859 by Prof. A. Newton. According to the latter, M. Josse Hardy had received the egg from Newfoundland; but on the other hand, Mesdames Le Bœuf and Ursel have assured me that it had been given by Temminck as a token of gratitude for much information he had received from M. Josse Hardy.

"This egg, which we were able to study on 3rd September 1896, has the following dimensions: Large axis, 123 mm., and the small axis, 78 mm. The two diameters intersect at 40 mm. from the thick end, or 0·325 from the greatest length. The shell is a little granulose, and is of a dirty greyish-yellow colour, with greenish-brown blotches accumulated, especially upon the thick end. It shows an insignificant crack and two little holes."

Press Notice.—At p. 262 I refer to the egg which at

[1] Professor Wh. Blasius, "Zur Geschichte der Ueberreste von Alca impennis Linn.," Naumburg A/S 1884, gives the date of the death of M. Josse Hardy as 31st October 1863.

one time belonged to Comte Raoul de Beracé, and which was sold for Messrs Jays, Limited, at the sale-rooms of Mr J. C. Stevens, 38 King Street, Covent Garden, London, on 27th July 1897, for 160 guineas, to Mr T. G. Middlebrook. On 7th August following, 'Punch' noticed the sale of the slightly cracked specimen, and published the following poem, entitled—

"The Lay of the Great Auk's Egg.

"Oh! talk not to me of Klondyke,
Coolgardie, Peru, or the Rand;
As investments they're failures alike,
Compared with the latest to hand:

But give me the Egg of the Auk—
The Great Auk—I ask for no more;
When it's cracked they can fill it with chalk,
Till it fetches its weight in gold-ore.

There are only just threescore-and-ten
Of such eggs in existence to-day,
And no longer a live specimen
Of the fowl any further to lay.

Each egg has a long pedigree,
Drawn up from the date of its birth;
They'll be smashed, till at last there will be
But one on the face of the earth.

Ah! then, if that egg were but mine,
My treasure at once I would float
In the City—the chance would be fine
An unlimited boom to promote!

I would turn myself into a Trust,
With a Board and the rest of the Tribe;
The Market we'd nicely adjust,
While the public would rush to subscribe.

The world, I am sure, would take shares
In my single and marvellous egg;
I'd buy up the arch millionaires,
And reduce them to work or to beg!

Alas! it is merely a dream,
For I haven't the guineas to spend
At these Auk-tions (ahem!) and my scheme
With my Lay of the Egg's at an end."

I believe this is the first time that the skin preserved in the Museum of M. le Baron de Vilmarest at Nielles-les-Ardes has been recorded in Britain, and Mons. H. Duchaussoy, who first drew attention to it, deserves our congratulations upon its discovery. It was to the same gentleman that I was indebted for the information that the skin that belonged to the collection of Mons. Ernest Delegorgue was amissing. I think that, although there is a missing link in the evidence, the probability is that this is the skin that I had recorded as belonging to the Hon. W. Rothschild, and figured on Plate III., p. 269. If it is not the skin from the Delegorgue collection, then it is an unknown skin, so that we have one skin at least, and perhaps two, to record as additions to my previously published lists.

Additional bones, representing at least, four if not five, specimens, appear to have been discovered in the kitchen-middens of the coast of Ireland, as I have just recorded, so these have to be added to former lists; and also bones from Danish kitchen-middens, representing at least eight individuals.

The summary of existing remains of the Great Auk or Garefowl (*Alca impennis* Linn.) may now be stated as follows:—

Number of birds represented by the following remains—

Skins	80	or	82
Skeletons, more or less complete . .	23	„	24
Detached bones	862	„	874
Physiological preparations . .	2	„	3
Eggs	71	„	72

Birthplace of the late Professor J. Japetus S. Steenstrup.—From the information contained in Chambers's 'Encyclopædia,' I gave, at p. 272 of this volume, Vang, in Norway, as the birthplace of the late Professor Steenstrup. I am now informed that his birthplace was Vang, in Thy, north-west part of Jutland.

[All changes of Alcine remains, noted by me to 31st July 1898 from 31st July 1897, are mentioned in this paper.—S. G.]

VI.—*CASTINGS OF OWLS.*

By Mr A. B. HERBERT.

(*Read Feb. 23, 1898.*)

Very recently a schoolboy found in a hollow tree near Guildford a number of small bones, which were carefully washed and brought to me for identification. There can be no doubt they are the castings of owls. They afford very convincing evidence of the utility of owls in the destruction of mice, and it is lamentable that so many of these useful birds should be destroyed by ignorant and prejudiced gamekeepers. It is my impression that many of the bones are those of field-voles (*Arvicola agrestis*). The skulls of birds are those of hard-billed species, probably sparrows or chaffinches.

Many years ago I kept a barn-owl in a large walled garden: he had one wing clipped, and became very tame, sleeping by day in a barrel, minus one end, placed horizontally, and wandering about the garden at night. By imitating in some degree the squeaking of a mouse, I could always bring him to the open end of the barrel for his food, which consisted of mice, small birds, and raw meat. He pinched the mice with his beak, perhaps to fracture the ribs, and then swallowed them entire, head foremost. His treatment of a bird was somewhat peculiar. Placing it under his claws, he first wrenched off the head and swallowed it; then he pulled off and rejected the tail and flight feathers of the wings; and lastly, taking the neck in his beak, by a series of spasmodic jerks the entire bird disappeared. I was not at that time aware that owls eject from their beaks the indigestible portions of their food, till on one occasion, on feeding my pet, he stood a short time near the food, and then, after many strange contortions of his head, the beak was opened wide and a black ball ejected. He immediately after took his food as usual. On examining the casting, I found it consisted of bones, fur, and feathers, the indigested remains of previous meals.

That owls are viewed by other birds as enemies I had once undoubted evidence. My owl had ventured out by daylight, and on hearing blackbirds uttering their sharp cries of alarm and anger, I went out and found the owl on a low wall, with many blackbirds darting about and mobbing him, till one more courageous than the others, made a rapid rush at him and knocked him off the wall. I then thought it prudent to interfere, and carried my bird to his barrel, when the tumult ceased.

Here we have frequent visits from a barn-owl, and one evening last June, when we were sitting out in the garden rather late, he came and made a dash, just over our heads, at a sparrow's nest containing young in a Virginian creeper. It was then getting dark, but we heard something fall on the gravel walk, which I presume was a young bird, and that the owl at the same time procured another from the nest.

In order to encourage our nocturnal visitor to a more intimate acquaintance, I have taken out a few bricks from a loft wall and placed a box inside against the orifice, in the hope that the owl may be induced to take possession of the box for the purpose of nidification. Should we be so far favoured, every protection will be afforded, and it will be very interesting to notice the food brought to the young.

We occasionally hear the wood-owl near us.

VII.—*WASPS: THEIR LIFE-HISTORY AND HABITS.*

By Mr A. MURRAY.

(*Read Feb. 23, 1898.*)

In giving the following notes on the wasp (*Vespa vulgaris*), it is not my intention to write a popular paper, but only to lay before you some of the many observations I have made on wasps in their natural state, and also a few of the experiments I have tried with them, extending over a number of years. I shall begin the life-history of the wasp in the spring with the queen or mother wasp, who, like most of the wild bees and other insects of a similar kind, hibernates during six or seven months of the year—say from October till March or April—when she comes forth in all her beauty and freshness of bright-yellow and black. Some queens are almost entirely yellow, others nearly black; and in certain seasons queens appear in enormous numbers. If the sun shines, they will usually be seen sitting upon the leaf of some shrub, the stem of a tree, or a wooden paling—in fact, upon almost anything the sun shines on except a stone wall; they very rarely sit upon it, and only where sheltered from cold winds. It appears as if the chief end of their existence was to sit about and sun themselves. Many a time I have seen one sit on the same leaf for over an hour at a time. However, if we watch her we shall see that she has some other end in view, for after resting for a while, away she flies leisurely along, keeping a sharp look-out for two things—viz., food and a suitable place on or in which to build her house, where a very large family is to be reared. We watch her flying along: she will be in and out among the trees, shrubs, and other things about. Next she will be under the bank, or skim along the bare ground into every hole and cavity, among grass, moss, or any other low plants, but always on the wing. Again she gets up to the trees and shrubs, flying along the sides of them, when suddenly she alights upon a leaf, but not to rest this time, for if we look more carefully we shall see that she has swooped down on the top of a poor fly who was resting on that leaf. If a small fly, and not disturbed, she will very likely dine off it there and then; if large, I don't know where she goes with it, but all the large flies are carried away. Of all the large flies I have seen caught, I have never once observed the queen wasp dine off one. My idea is that, not being able to comfortably hold a large one on a leaf, she flies off to some warm bank, there to feast in comfort. This kind of work goes on for two or three weeks; then we begin to see some variation. A queen will be heard or seen preparing material for making paper with which to construct her future home. If we hear a low rasping sound and look around, we shall be sure to find a piece of paper on which is a queen wasp, scraping off with her strong mandibles some of the fibres with which she is to make her own paper. If we do not hear one, we shall be sure to see one on a decaying tree stump, the dead branch of a tree, or an unpainted paling rail. In some seasons it is by no means difficult to see them, as they are very numerous. One year, at a meeting of the committee of the Fifeshire Bee-keepers' Association, we agreed to collect all the queen wasps we could get. I set to work, determined to do it well, and in a few weeks had collected a number that surprised me very much. Although I knew I would get many, I was not prepared for 640, which was the number I killed. On going to catch or kill a queen wasp in the spring, one has to be very careful how he goes about it, as she is very sharp with both ear and eye, and if the first chance is missed there is very little hope of a second. For several days that queen will be exceedingly wary, and seem always to be on the watch, and you are very unlikely to get within six or eight feet of her. It may be imagined that I must have gone over a large stretch of country in order to collect so many queen wasps, but such is not the case, for, with the exception of a very few, say the odd 40, which my boys killed, the 600 were all got within a space of about 200 yards in length by 100 in breadth. That will give you some idea of the number of queens that get safely through the winter. If all, or even the half, of these wasps formed a colony, they would be a perfect pestilence; but the birds are always very busy among them, and kill many. Another thing that destroys many of them in the spring is the wet weather, which kills more than the cold. A wet autumn also kills many. If the winter has been a very mild one, with a week or two of warm weather in the end of March or beginning of April, it often brings out the wasps, and then a few cold wet days and nights will kill most of those that have moved from their winter quarters. A severe winter and a late spring will give us more wasps—and other insects—than a mild one, as in a cold winter and spring they remain dormant until the fine weather: then they come from their winter quarters vigorous and lively. The idea of many that a severe winter kills numbers of insects is scarcely correct. I believe a mild winter is more harmful to insect life.

But we left our queen gathering fibre to make her nest with: we shall now follow her to the place she has selected, which in this case is under the roof of a beehive, where she arrives and lays the foundation of her nest, house, castle, or palace, any of which names may with justice be given to it. It is really a beautiful structure. The queen or mother wasp has alighted, and there she sits as if gone to sleep: the only sign of life is the jaws or mandibles working hard, making pulp with the fibre she scraped off the paper. Before we have been able to notice that anything was done, she is gone. If we examine where she sat, we will see a small irregular patch of dark-grey matter, which on becoming dry is light-grey. Our queen may go on sticking patches without order or apparent reason over a large surface, or she may make one large patch, or she may start right off and make a small column or cord of a hard material a little over half an inch in length, at the end of which she forms one or three cells, in which, while yet very small or shallow, she deposits in the centre of each an egg. Having occupied from two to five days in performing this work, in another week it will have assumed the size and nearly the shape of a large walnut or small egg, only a little more circular, in which there will be from ten to twenty worker cells, some containing larvæ, some eggs.

In the 'Strand Magazine' for January 1898 there is an article on wasps by Grant Allen, which is very well written, but should not be read by any one desiring correct information regarding wasps, for he will not get it there. The three drawings of the wasp's nest, of two, five, and fifteen days old, have no resemblance to nests of these ages—at least, I fail to see any, and I have seen hundreds, for it was at this stage that I performed my experiments with them, a few of which I shall now notice. One day, on opening one of my beehives, I found a small wasp's nest under the roof, which I at once pulled off and dropped into my coat-pocket to examine it at leisure. About half an hour after, on taking it out, I was surprised to find a queen wasp inside, and the peculiar thing about it was that she would not be advised to come out, but went on spinning and buzzing around the small column from which the cells are hung. Finding the queen so averse to leave her nest, I thought if this was a general habit I would be able to prove to my own satisfaction whether the wasp that hung its nest from a tree or bush or any projection, exposed to light and the weather, would also build its nest under ground or in any other dark cavity. Upon trial, I found that the majority of the queens were determined to stick to their nests, so I could carry them where I chose. I gathered many from trees, lintels of doors and windows, beehive roofs, &c., and buried them under ground, of course taking care that there was a suitable cavity and a road into it, and found that in most instances they did as well as if they had chosen the place for themselves. The only cases of failure were where the queen was lost. Only once was I able to take a nest out of the ground. That one I hung under the branch of a pear-tree upon the garden wall, and the wasps made a nest 6 inches by 8 inches before I destroyed it. From these and many other experiments I came to the conclusion that the wasp that made its nest on a tree, bush, or any place exposed to light and the weather, and the one that made it under ground or in any other dark sheltered cavity, was one and the same wasp. I cannot see the slightest difference between them, either in the construction of their nests or in their general habits. Sometimes there was a difference in the colour, which I shall notice further on. It is most wonderful how wasps suit themselves to the place and material where the nest is built. I once found an old nest with a stone as large as a duck-egg stuck right in the centre of it. It happened thus: the stone was among soft earth, which was all carried out, but the stone being too hard to gnaw to bits and too heavy to carry out, they built round, fixing it firmly in the combs of the nest. Once I took two nests, and hung one to the branch of a tree; then about two inches below I hung, bottom up, a small flower-pot, and inside the pot I hung the other nest. Both nests increased in size quickly, and in course of time became one nest, the one building down until it completely enclosed the other, and there was no sign of trouble between the two families, but both became one colony and seemed to be contented.

Allow me to say a few words about the wasps' nests exhibited at our December meeting, as it was this exhibit that moved me to write this paper. On the "billet" it was called the nest of the tree wasp, but at the meeting we were told it was the nest of the hermit wasp. That there may be hermit and tree wasps I shall not dispute, though I have never seen them. But I am of opinion that the nests shown were only the early stages of the common wasp, the queens of which were lost in some way or other, when of course the nests never were built to their full size, and the few worker wasps died in the cells. As to size and colour, which some members thought proved a different variety, one cannot very well judge from these in a dead wasp, as then they shrink very much, and are always darker. I have noticed also that the earlier workers are much smaller than those hatched later in the season. These unfinished nests are far more common than the finished ones, because many queens begin nests, but few live to finish them. If a nest the size of those shown, or larger, contained worker, male, and queen cells, then it might justly be called the nest of the hermit wasp—certainly it could not be the common wasp's nest; but without these different cells, no hermit or any other wasp could perpetuate its species. The nests shown at the December meeting contained only worker cells.

Now we shall have a look at our wasp's nest: we left it about the size of an egg, and by this time it will be some four weeks since the first eggs were deposited. There will now be between twenty and thirty lively workers building as fast as they are able, increasing the breadth of comb, and by-and-by starting another tier about three-eighths of an inch below the first, and hung from it by small columns of the same material as the first column was made of. The cells in this tier will be all the same size as the first. I never found fewer than two—sometimes, but not often, three—tiers of worker cells. On the edges of the third comb there will frequently be large cells, the centre being filled with worker cells: the fourth, fifth, and sixth, if there should be so many, will be all male and queen cells. I have occasionally seen seven tiers of comb in a nest; but five is the usual number, when two will be worker and three male and queen cells. I think it is very apparent why there are no queen or male cells early in the season. If the cells were there, they must be used; and if queens were too early hatched, they would be too far advanced before going into winter quarters, and likewise run more risk of being killed by having to fly about so long.

There must be a great many queens hatched from each nest: roughly speaking, there must be 2000 large cells in each nest containing a male or queen. Allowing three males to every queen, that gives us about 500 queens from one nest. These begin to hatch about the end of August, and by the end of September the queens will all, or nearly all, have got into their winter quarters. In the 'Strand Magazine' article already referred to, the writer says, "In the autumn the queen lays eggs which hatch out a brood of perfect females: last of all, as the cold weather sets in, the queen lays some other eggs, from which a small brood of males is finally developed." That, of course, is a mistake, as the drones are always hatching before the queens are started—first, because it takes twenty-four days to hatch males, and only eighteen to hatch out a queen; second, it is very necessary that the males should be matured before the queens are about, as they must be mated before they are six days old: between two and five days is the usual time. This writer further endeavours to make out that it is only when the queen is old and enfeebled that she deposits male eggs. Now there cannot be the slightest doubt that the reason why male eggs are deposited earlier than queen eggs is that the males may be matured and ready to mate with the queens when the latter hatch. The same writer says: "Drones or males are of little account." I wonder what would be the use of the queens without them! I believe that, if it were necessary, the queen could lay male eggs the first week of her depositing; and as to being old or enfeebled the first year, I have an idea that she may, like the queen bee, live for two or three years if no accident befalls her. A queen bee will live for five years: I have had one over that age in my possession, and I have had them depositing male eggs the first month of their lives. It is a fact that they can deposit either kind of eggs at will. Male eggs are really unfertilised eggs. If a queen bee has not been mated, all the eggs she deposits will hatch out males; and I believe that wasps are very similar to bees in that respect.

I have made wasps build their nests in almost every conceivable place and position. I once allowed one to build its nest to a great size in an empty beehive. It was eleven inches from side to side and ten inches from top to bottom. Wasps' nests are usually deeper than their breadth; and although inside a hive, and sheltered from the weather, this nest had the thickest walls I ever saw: they were at many places an inch and a half in thickness, and with from five to nine plies or sheets of paper. When the males began to appear, I sent them to sleep with cyanide of potassium, and then dissected the nest. I put most of the combs containing brood into boxes with glass lids, and hatched them out on the top of a beehive. It was then that I saw colour had nothing to do with varieties, as there were all possible shades, from nearly yellow to black—*i.e.*, with broad yellow bands and narrow strips of black, and *vice versâ*. I have had them build their nests in boxes, and have then turned the boxes on their sides, or even upside down. If this was done early in the season, and the combs were small, the little workers would begin to build new cells with the mouths at the lower end; but if done later in the season, they seemed perfectly content to go on with the cells upside down or on their sides. I have, by an arrangement of entrance tubes, sent the wasps of one nest into the other, and there was such a commotion and fighting; but, strange to say, I never noticed any killed, and next day they were going on as if nothing had happened. If this were done with bees, half of them would be slaughtered. I have also set queen wasps to fight with each other, but never saw them continue till the death of one, as queen bees do.

I do not think there is another insect with such varied tastes in feeding as the wasp. We may safely say that wasps will eat everything, be it tasteless, salt, sweet, acid, or any mixture of flavours. If they come upon, say, a mouse, or a bird, newly killed, and fresh blood about, then the wasp will have a drink of it. If there should be a bit of raw flesh, she will be at it. Whether it be fresh fish or salt herring, it is all the same to the wasp; and she will leave the salt herring and take the next mouthful from a honey jar if she can get it. Fruit of every kind she consumes and destroys, and it is astonishing how quickly a few of them can clean out a peach, plum, or pear. Many a time I have plucked a fruit which, to all appearance, was sound, but on taking it in my hand, I found it was only the skin of the fruit with a small hole at the back, while inside were from sixty to a hundred wasps, so firmly packed that one wondered how ever they got in.

It may not be out of place to say something regarding the stinging propensities of wasps. To do anything about a wasp's nest without first closing the door is a sure way of getting a very warm reception. A hanging nest had better be given a wide berth, seeing it cannot be closed in. If you have once disturbed the wasps, you cannot get too quickly out of the sight of their nest: if they cannot see you from the entrance, you are not so apt to get stung. I once observed a very large nest up a tree, some twenty feet from the ground. Tying two or three rails together, end to end, I pushed this up gently until it was quite close to the nest, and then with one thrust sent the whole flying to the ground. I immediately tried to fly myself, but I found the wasps could do so much faster, for I had scarcely turned when two little rascals were busy on the back of my neck. These stings took me more by surprise than any others I ever got. If the nest is in the ground, no one need be afraid to sit down at the side of it and eat his lunch: all you have got to do is to pull a handful of grass or moss and stuff it into the hole. So long as you keep the wasps in that were in the nest when you stopped the hole, you are safe: those that are out will not sting, although you may be surrounded by hundreds. They are too eager to find the entrance to their nest to take notice of any one. Both bees and wasps are the same in that respect: close the entrance to the hive, and those coming in will not sting you although you sat on the alighting board. As a rule wasps are very easily annoyed, and fly at all intruders; yet sometimes one may do a great deal near the nest without being stung. I remember once clipping a tall beech hedge in which there was a wasp's nest, and although the nest was less than a foot from my shears, and it must have taken me a considerable time to get past it, while all the time shaking the hedge and making a noise with the shears, yet I did not get stung. Two women who were raking the prunings got very badly stung, however. I went to see what the commotion was about, and got stung as well,—my first intimation of a wasp's nest being there. Another time I went into a wood with a gun to get a shot, and was walking very slowly and quietly, when I was made aware of being in front of a wasp's nest by a sting on the face. In the first case I was shaking the nest and making a noise, with quick movements, all of which annoy wasps very much, yet I did not get stung. In the other case I did not disturb them in any way, and yet got stung at once. There is one thing in this connection which puzzles me much, namely, how a blackbird can stand at the side of a hanging wasps' nest and tear it to pieces to devour the larva, and yet not be stung to death. The bird does not seem to be annoyed in any way, but if I venture to see what is going on, I am certain to be very much stung—I suppose, for not minding my own business!

There are a great many other interesting things that could be said about wasps, but I have already taxed your patience too much. So just a few words more and I am done. It has been suggested that I might say a little about the scarcity of wasps as compared with twenty years ago. It is very doubtful, however, that there are really fewer wasps now than formerly. In the summer of 1893 a friend and I walked up the road from near Little France to Craigmillar Castle, and between where we turned up and the castle we saw six strong wasps' nests, and that within half a mile. That does not seem as if they were scarce. But the number of wasps varies much according to weather. After a winter like the one we have just had the wasps are likely to be scarce. The warmth brings them from their winter bed; then a few frosty nights come, and having taken shelter in a damp or exposed place, it is generally fatal to them. To study wasps, one must live in the country among them. A visit to them now and again is not enough: that will give but a very incorrect knowledge of their life-history and habits.

A few words in conclusion about how to trap or destroy wasps may not be out of place. There are many ways of doing this. I shall speak of hanging nests first. Sometimes a roll of paper is lighted and held under the nest until it is all burnt; but this method is rather cruel, as many of the insects only have their wings singed, and crawl about for days in that state. To suffocate them with the fumes of burning sulphur is better, if carefully done; but I think the quickest and best plan is to take a 6-inch or 7-inch flower-pot, cork the bottom hole, and fix a stick across near the top; then saturate a piece of wadding in a solution of cyanide of potassium, and hang this over the stick, holding the pot under the nest after the wasps are all in, when the job will be finished in ten minutes. Ground nests are also best treated with cyanide of potassium. Put a bit of wadding or rag with the cyanide in the mouth of the hole—taking care not to close it up—some time during the day: in the evening dig the wasps out, and with a can of water mix the soil with the combs in a mortar, and fill up the hole. If the combs were not thus broken up, all the wasps would hatch out, and keep the colony going.

I have tried many other methods of destroying wasps' nests, two of which I shall mention before I close. One is to burn a squib or ball of wetted gunpowder in the hole. Then dig up the wasps while they are stupefied, and treat them as before by mixing soil and water with the combs. Another plan I have often adopted, and by means of which I can tell very nearly the exact number of wasps in a nest, is as follows: I go at night, after all the wasps are in, and stuff up the hole with some grass. Then two or three quart bottles, about one-third full of water, are buried with the top of the neck nearly level with the ground, and as near to the entrance of the nest as possible. Care should always be taken, if the hole goes north, to dig on the south side, and *vice versâ*. After the bottles are in, and the earth all level and smooth, I pull the plug out of the hole and run. Next day, about midday, if bright, I plug up the entrance to the nest, and it is surprising how quickly the bottles are filled. The wasps, on returning, cannot find the entrance, and look about for some time, when they find the necks of the bottles. If one goes in, it is all right: the sound of that one takes in the others very quickly. It is really wonderful how unhesitatingly they tumble into the bottles, never to get out again. By this plan, in two days you can get almost every wasp, and then you may count them at your leisure.

VIII.—*DAUBENTON'S BAT.*

By Mr CHARLES CAMPBELL.

(*Read March 23, 1898.*)

The Cheiroptera or Bats are the most curious, if not the most interesting, group of mammals. Every one is familiar with their shadowy forms, as they flit here and there, in ever varying circles, in the twilight; but where they have come from, or where they disappear to when the twilight has deepened into darkness, has always been to me somewhat of a mystery. There are, I believe, twelve different species of bats found in Britain, but only half that number have been recorded in Scotland. Even the distribution of these few in our country is but imperfectly known, and there is much that can yet be learned regarding them. In January 1895 Mr Symington Grieve read a paper before this Society giving a detailed account of the occurrence of Daubenton's bat in the rocks that border Loch Dochart, Perthshire—the first record of its appearance in that county. It is to the capture of the same species in Argyllshire that I now refer.

Kinlochaline Castle, as its name implies, is situated at the head of Loch Aline, an inlet from the Sound of Mull, in the parish of Morvern. In the long summer evenings I had often watched the bats issuing from the old tower, and flitting up and down the river; under the shade of the trees, or wheeling in larger circles across the surface of the loch. I had always suspected the presence of other species than the pipistrelle and the long-eared bat, but I was never able to capture or identify one until last summer. One afternoon, when having a last look round the old building for the season, I discovered in one of the lintels a crevice which gave unmistakable evidence of the presence of bats, but the puzzle was how to get them out. The wall, built to withstand a siege, as it had often done when times were more troublous than now, was of too stout material to be even partially loosened, and the crevice was too small to admit of them being got at with a stick. I was despairing of making a capture, when I thought of trying the effect of smoke. With a few scraps of paper and a match I soon made the trial. As the smoke began to find its way upward through the crevices in the wall, I could hear the bats rustling and chirping in their retreat, and then a single bat darted out, followed by another and another in quick succession. I caught as many as I could with my hands, but found they scrambled out of my pockets as fast as I put them in, and it was only by pinning down the flaps of my pockets that I managed to retain possession of a dozen of those I had captured. At least fifty came out at this aperture, and were flying about the vaulted chamber in the castle. I saw a good many alight on the walls and disappear into holes away out of reach, where some more of their kind rested secure from any rude disturber of their peace. I had never previously come across Daubenton's bat, and was not quite sure of the species, so I sent some by post to Mr Wm. Evans, who identified them as Vespertilio Daubentoni. This species is not included in

Messrs Harvie-Brown and Buckley's 'Fauna of Argyll,' and is the first capture, as far as I am aware, of the kind in the county. In the immediate neighbourhood of Edinburgh, Daubenton's bat has been caught at The Inch, near Liberton, by Mr Speedy; and this and other records of its occurrence will be found in Evans's 'Mammalian Fauna of the Edinburgh District.'

IX.—*ON THE DIATOMACEÆ.*

By Mr J. RUSSELL.

(*Read March 23, 1898.*)

The first point which will engage your attention will be the answer to the question, What is a diatom? In botanical science the Diatomaceæ form a sub-order of the natural order Algæ, and this sub-order is divided into two sub-sections—(1) Diatomeæ, microscopic plants with a siliceous epidermis; and (2) Desmidieæ, microscopic plants without a siliceous epidermis. It is to the first of these sub-sections, the Diatomeæ, that my remarks will be confined.

The term diatom is given to the plant from its peculiar mode of multiplying itself, the mother plant being, as it were, *cut through* into two halves, each half forming a complete plant in itself, and *cut through* in its turn, forming again other two new plants. If we consider the diatom as a unit, it is a one-celled plant of very small dimensions—how small it is somewhat difficult for the mind to grasp. Some of the larger circular ones are about $\frac{1}{100}$ of an inch in diameter, while some of the smallest are less than $\frac{1}{2000}$ of an inch in diameter. I have called them plants because it is now almost, if not altogether, universally recognised that they belong to the vegetable kingdom: it was not always so, some of the earlier workers considering some at least of the genera as belonging to the animal kingdom.

The term *frustule* is applied to the diatom as a unit. In most, if not in all, species, the *case*—if the term may be allowed—of this frustule consists of four distinct parts—two sides, top and bottom—to which the term *valves* is applied. Running round the margin of each of these valves is a band or hoop, the one of which slides into the other: these bands or hoops are called the *connectives.* The four parts—the two valves and the two connectives—thus form a small box, and, if we take a circular specimen as our example, the thing it most resembles is a small pill-box. These valves of the diatom are composed of silex, quite transparent, and practically indestructible, so that they withstand—except some of the more delicate marine species—boiling in the strongest acids. This boiling process, of which more anon, is necessary to reveal what many consider the great beauty of the diatom valve, its peculiar markings and tracery, the variety of which seems endless. The form of the valve is of all conceivable shapes, from linear to circular.

The principal of the contents of the diatom frustule are the protoplasm, the endochrome or colouring matter, and oily globules scattered throughout the cell. Embedded in the protoplasm is the nucleus or embryonic germ, the function of which is the multiplication and reproduction of the cell. The whole of the frustule is covered by a mucous membrane, which in some species is prolonged so as to form a *stipes* or stalk, by which the frustule is attached to some other body.

I have said the function of the nucleus is the multiplication and reproduction of the cell or frustule. In giving an account of these phenomena, I will follow Dr P. Miguel, who has bestowed much time in their elucidation. The multiplication takes place by the division of the cell, each half forming a new cell. This is effected by the protoplasm increasing, and thus forcing the two valves apart. At a certain stage in this process the nucleus also divides, and thus each half goes with the divided protoplasm: while this is being accomplished, a new silicious covering or valve has been forming upon each of the inner faces, so that when the separation of the two halves actually takes place, each frustule is complete in itself, with its two valves and its connectives, its protoplasm and its embryonic germ, and the other constituents of the contents of the cell. Before the two halves were completely separated, and while they were still being held together by the external mucous membrane, a new silicious valve was being elaborated for each of the halves, so that, when the separation did actually take place, the contents of the cell would be completely protected on all sides by its flinty case. The new cells thus formed are, however, smaller than the old ones by double the thickness of the connectives. It is thus evident that by this process of multiplication a time would come when, by this continual decrease in size, the frustule would cease to exist, and this order of vegetable life would come to an end. Nature has, however, provided a remedy, and another process of reproduction takes place, by which a new frustule is formed of the original size. Diatomists are not all agreed as to the mode in which this reproduction takes place. Here again I follow Dr P. Miguel, who has actually observed it in some species. In multiplication by division the protoplasm has increased in a direction parallel to the line which unites the nuclei of several frustules—that is, supposing such a line to be drawn. This has the effect of forcing the valves apart. When, however, a certain stage in the decrease of the size of the frustule has been reached, the protoplasm swells out, in a direction perpendicular to this line, on both sides, until it reaches the original size of, or perhaps larger than, the parent frustule. The protoplasm as thus increased is a soft mass, but it soon secretes to itself a silicious envelope, though it requires to pass through two or three generations before the exact form of the original frustule is attained.

Different genera of diatoms have different modes of life. Some are free, — that is, each new frustule after division separates itself entirely from the parent frustule and leads an independent life: others do not entirely separate themselves, but remain attached by their external mucous membrane, and thus forms chains, some in a direct line, others in zigzag. Some are attached to higher algæ, and spread out in the form of a fan, while others live in tubes attached to stones in shallow waters round the sea coast. I have collected some of these tubes, more than an inch in length, packed full of living diatoms.

Habitat.

Where are diatoms to be found? Some are peculiar to fresh water, others to salt water, while others are to be found only in brackish pools. In slowly running streams you will find them covering some of the stones with what appears to be a brownish slime, or you will find them adhering to grasses on the margin of the stream, or to dead grasses floating in pools of clear water; you will find them adhering in gelatinous masses to the faces of rocks or the sides of caves where there is any water trickling down. In a word, wherever there is slowly running or trickling water, you will find fresh-water diatoms. The prevailing colour of these diatoms in the mass is golden or dark-brown.

Marine forms you will find growing on the slender algæ in pools among the rocks on the sea-shore. A particular genus (Licmophora) you will find growing abundantly on the upper part of the slender, hair-like Litosiphon pusillus, imparting to that pretty alga a somewhat cloudy, dirty appearance. Again, where there is a bed of mud which is covered by the tide at high water, such as some of the mud-beds on the shore at Cramond, you will find a beautiful carpet of diatoms glowing with a dazzling sheen as the rays of the sun fall slantingly upon them; while on boulders in the shallow water on the sea-shore you will find the mucous tubes of the Schizonema. Another excellent soil for diatoms is the mud in pools filled by the tide at high water on marshy ground along the sea-shore. Some of the best gatherings of Pleurosigma I have ever made were got in such pools in the marshy ground on the sea-shore near the North British Railway station at Montrose. Again, where there is a burn falling into the sea, with its outlet somewhat closed by shingle, so that a pool affected by the tide is formed, and in which some twigs may be floating, you will likely find on these twigs a rich harvest of diatoms.

As the algæ to which the diatoms adhere, and probably the diatoms themselves, form part of the food of certain fishes and of some mollusca, some excellent specimens have been found in the stomachs of these creatures. The task of searching for them is, however, a laborious one.

I have hitherto been speaking of living diatoms. There are, however, in many parts of the world, large beds of them in a fossil state. In Scotland there are several of such deposits, both on the mainland and in some of the islands on the west coast. The one of which I have personal knowledge, from having visited it, is the Kinord deposit, near Dinnet, in Aberdeenshire. It is several acres in extent, and the diatomaceous deposit is several feet in thickness, lying under a surface layer of peat moss. To a casual observer the whole appears as if it were ordinary peat, its colour before it is dug out resembling that of peat. When it is dug out and dried, it assumes a light-grey colour, and is very light in weight. Some of the best patches of it are pure diatoms "bound together by fragments of Sphagnum, Equisetum limosum, E. fluviatile, &c."

The Rev. Dr Davidson, minister of the parish of Logie-Coldstone, whose manse is near the deposit, has made an exhaustive examination of it, and has identified 200 different species of diatoms. You will find the list of these in a paper by Mr W. Ivison Macadam in the 'Trans. Geol. Soc. Edin.,' vol. iv., part iii., p. 207. Dr Davidson was the first, I believe, to draw attention to the value of this deposit as a commercial article. When it is dug out and dried, it is exceedingly light and porous, and has thus great absorbent capacity. It was thus thought it would take the place of the German "Kieselguhr" in the manufacture of dynamite, and for some years large quantities were taken by Nobel's Explosives Company. Of late years this demand has somewhat slackened, but there is still a small trade in it being done.

On the occasion of my visit, Dr Davidson drew my attention to an interesting fact bearing upon the nutriment necessary for diatoms. Thus on the west side of Loch Kinord a burn falls into the lake, the water of which is charged with silex, and it is here that the diatoms are found in great quantities. Close to Loch Kinord there is another lake, Loch Dawin, which is fed by a "stream which takes its rise about five miles distant, on a hill, mostly consisting of hornblende, and in it scarcely any diatoms, either fossil or recent, are to be found."

Collection.

Now that you know where diatoms are to be found, your next stage is to collect them. Of course in the case of fossil-beds all that is necessary is to take a sample of the deposit. For the collection of living diatoms, no costly apparatus is necessary. An attentive eye and good judgment are the best requisites. It will also save time and disappointment if, in your outfit, which may be very modest, you have something which will enable you to test a gathering upon the spot. This can be done by a pocket-lens; but the most convenient form of lens for this purpose is that known as an Algen-sucher, which can be purchased at any optician's—at least at any optician's who is agent for a German house—for a few shillings. To carry your gatherings home, you require a number of wide-mouthed bottles of two or three ounces capacity, and with good corks. For the purpose of wrapping up gatherings of wet algæ, pieces of waterproof sheeting are necessary; while for the purpose of scraping up the diatoms from the face of rocks or sides of caves, or from the surface of stones or mud, an iron spoon, or a piece of tin-plate bent to suit, is required. For cutting diatom-bearing algæ growing in pools in the rocks on the sea-shore, a dessert knife is as handy as anything. For those who desire to collect in deep water, something more pretentious is necessary. If the water is not too deep, and the collecting can be done from the land, a stick which can be lengthened after the manner of a fishing-rod can be used. To the end is fastened an iron spoon with a broad sharp edge to its mouth, which must be bent inwards, so as to scrape along the surface of the bottom of the pool. If the searchings are in such places that a boat is necessary, then a drag-net of some kind is required.

When a gathering is made, and, after being tested by the Algen-sucher, is found to be worth taking home, it is placed in one of the wide-mouthed bottles, and a little water from the same place added to keep it moist. The bottle is corked, and labelled with the place where and the date when the gathering was made. If it is algæ or grasses to which diatoms are adhering which have been gathered, they are best taken home wrapped in a piece of the waterproof sheeting, which must be also duly labelled. On arriving at home, no time should be lost in taking the corks out of the bottles and in spreading out the grasses or algæ to dry, unless it is intended to try to cultivate the diatoms, in which case they must be transferred immediately to suitable water. If many gatherings have been made on the same day, some kind of bag or haversack may be necessary in which to carry them home.

Preservation.

Having got the diatoms home, the next step is their preparation for examination under the microscope, and a great deal depends on the manner in which this is carried out whether the examination will give real pleasure or not. It will be advisable to mount some of the diatoms in their natural state on the ordinary microscopic glass-slides in cells. A cell of sufficient depth and size is made, and when *thoroughly dry* it is filled with some preservative fluid. As good a fluid as any for this purpose is distilled water to which has been added a trace of carbolic acid—one part of acid to a hundred of water. Good specimens of the diatom or gathering to be preserved are chosen and placed in the cell and suitably arranged, if necessary, under the mounting microscope. Before sealing up the cell, it is well to allow it to remain for a day or two securely protected from dust under a small bell-glass, so that any bubbles of air may escape. When about to seal the cell, it must be seen that it is full of the fluid, and, if necessary, a drop or so must be added. A cover of thin glass of the requisite size, and thoroughly clean, is taken up in the forceps; its underside is gently breathed upon, so as to cover it with a film of moisture: its edge is then rested upon one of the sides of the cell, and the cover is lowered gently, and in such a manner as to drive a small wave of the fluid before it. If this is carefully performed, no air-bubbles should be enclosed, and the cell is ready to be sealed up, which is done by running several layers of cement round the edge of the cover-glass and top of the cell. The mount is then labelled and put past till dry.

Cleaning.

To see the valves of a diatom in all their beauty, they must be cleansed from all adherent matter of every kind. This is called the process of cleaning: it is slow and tedious, and demands great care and patience on the part of the operator. The order of procedure depends upon the nature of the material to be cleaned. I shall take one or two typical cases and treat them at some length.

I shall suppose the gathering to be a fresh one, taken from the surface of mud on the sea-shore. There will be mud and sand and small stones mixed up with the diatoms. The gathering should not have been allowed to get dry. A test tube of large size is taken, and a quantity of the gathering put into it: it is then filled to within an inch or so of the top with *soft* filtered water; if the water is what is called *hard*, it should be boiled before being filtered. The tube is vigorously shaken, and then allowed to rest for half a minute till the heavy particles fall to the bottom. The supernatant liquid is then poured into another glass vessel, carrying with it a quantity of the diatoms. The tube is again filled with water and again shaken, and the supernatant fluid as before poured into the other glass vessel. This process is repeated till it is supposed all the diatoms have been separated from the heavier matter and carried off into the other vessel. What remains in the test tube is thrown away, and the tube thoroughly washed out. The vessel into which the supernatant fluid from the test tube has from time to time been poured is allowed to remain at rest for an hour or so, till all the diatoms have sunk to the bottom. The water is then carefully poured off, except so much as may be necessary to wash the sediment back into the test tube. The tube may then be allowed to remain at rest till the diatoms settle down, when the remainder of the water can be poured off. The sediment in the test tube is then covered with nitric acid to a depth of from half an inch to an inch, according to the quantity to be operated upon. The tube is then exposed to the flame of a spirit lamp and the contents boiled from five to ten minutes. The fumes given off during this process are very deleterious, and must not on any account be inhaled nor allowed to spread in the room. In boiling, care must be taken that no solid matter in the tube is presented to the flame, otherwise the tube will crack. With care a tube of English make will last a long time. When the tube is cool after the boiling, it is filled with water and allowed to stand for an hour or so till the diatoms settle: the water is then poured off, and this process is repeated till the whole of the acid is washed away. As this water will be highly acidulated, care must be taken as to how it is disposed of.

To get rid of any organic matter which may be mixed with the diatoms, the deposit in the test tube is covered with a sufficient quantity of sulphuric acid, and the boiling recommenced and continued till the contents are of a dark, inky colour. This colour must then be discharged, which is done by dropping into the boiling sulphuric acid small grains of crystals of chlorate of potash till the contents are clear. This is altogether a very delicate process, and requires to be gone about with great care. In boiling, the mouth of the tube must be held away from the direction of the face or any part of the body, as the acid is apt to be projected out of it. A good plan is to have a glass stirring-rod in the tube stuck through a disk of stout paper covering the mouth of the tube. The chlorate of potash must also be added very carefully, and in small quantities, otherwise an explosion will take place, shattering the tube and doing damage all around.

The contents of the tube are now emptied into a beaker-glass half-filled with water. This glass must be a thoroughly tempered or annealed one, else the great heat engendered by the mixing of the sulphuric acid with the water will break it and cause the contents to be lost. It may be found advisable before emptying the tube into the beaker-glass to fill the tube with water. This can be done without much danger by allowing the water to trickle down the side of the tube. The contents of the beaker-glass are now allowed to stand till all the diatoms fall to the bottom. The supernatant liquid is then poured off and the glass again filled with water, which, after the diatoms have settled, is poured off. The process is repeated till all the acid has been washed away. The sediment in the glass should now consist of diatoms, sand, and flocculent matter. To get rid of this flocculent matter the whole is again transferred to the test tube, along with a little water. A small pea of hard yellow soap is added, and the whole boiled for five minutes or so. In the boiling there will be danger of the contents being projected out of the tube. This can be obviated by using the stirring-rod, as recommended in the case of the sulphuric acid.

The contents, after having been well shaken, are poured into the beaker-glass, which is filled with water, allowed to stand till the diatoms have sunk to the bottom, and then the water poured off. This is repeated till all traces of the soap have been washed away. The bottom of the beaker-glass should now be covered with a white layer of greater or less thickness, according to the quantity of material used. If the various processes have been successfully performed, this layer should consist of pure diatoms and sand. To get entirely rid of the sand is next to impossible. A great portion of it can be got rid of by filling the beaker-glass half-full of water, and by the hand imparting to it a circular motion, when the diatoms will rise in a spiral column and the heavier sand will gather in a small heap in the centre of the bottom. The water with the diatoms can be gently decanted, and this can be repeated till a fair separation has taken place and you find you have a tolerably clean quantity of diatoms.

The gathering which formed the subject of this process of cleaning was supposed to be one from the surface of mud on the sea-shore. Of course the same treatment will suffice for gatherings from other surfaces, such as stones in the water, the faces of rocks, and the sides of caves. If the gathering is one of higher plants to which the diatoms are attached, the first process is to get the diatoms detached, which can generally be effected by steeping the plants in dilute nitric acid. When this is done the whole of the boiling and washing processes before described have to be followed. When it is a gathering from a *fossil* deposit which has to be cleaned, and the diatoms are embedded in a substance of a more or less hard consistency, the first stage is the thorough pulverising of this substance. This can usually be accomplished by boiling the gathering, broken into small pieces, in a test tube along with a pea of potash or even of common washing-soda. As the diatoms are, however, liable to be destroyed in this process, care must be taken to stop the boiling the moment the mass is pulverised, to fill up the test tube with water, and to continue the washing till all traces of the alkali have been removed. The boiling with acids and washing, as before described, must now be followed. In all these processes the Italian proverb, *Festina lente,* is most applicable.

Now that we have got them cleaned, we wish to preserve them for future examination. This can be easily done in well-corked phials of distilled water to which a small quantity of alcohol has been added to prevent confervoid growths. It is recommended in text-books to use distilled water in all the processes. I have found *well-filtered boiled* water sufficient.

Mounting.

To have diatoms preserved in a permanent way so that they can always be readily examined under the microscope, they must be mounted. This is generally done on the usual microscope glass-slides, 3 inches by 1 inch being the English size. The diatoms should, however, be fixed on the underside of the thin glass, known as the cover-glass. There are two processes of mounting—mounting dry, and mounting in one or other of the different media, and here I am speaking of what are called *spread* mounts.

Dry Mounting.—The preliminary steps in dry mounting and mounting in a medium are the same. If the diatoms have been preserved in alcohol and water, it is advisable to put them in a test tube and wash away all the alcohol with distilled water. Having thoroughly cleaned your cover-glass—circular cover-glasses are the most convenient for this purpose—lay it upon your small mounting plate, and cover it with a bell-glass to keep off the dust. It saves trouble to arrange to make several mounts at the same time. A pipette must now be used. A very convenient form is a glass tube about eight inches or so in length and five millimetres in internal diameter drawn to a point. The diatoms in the test tube are well shaken, and a sufficient quantity taken up in the pipette. By putting the finger upon the top of it, the diatoms are retained, and the flow from the point can be easily regulated by the partial withdrawal of the finger. The cover-class is now breathed upon, and a quantity of diatoms sufficient to spread over it is allowed to flow from the pipette. The process is repeated till all the cover-glasses are filled. They are now put aside under the bell-glass till the water evaporates and the diatoms are left dry upon the glass. The drying may be hastened by placing a spirit lamp with a small flame under the mounting-plate on which the cover-glasses have been arranged. If diatoms of different gatherings are being mounted the pipette must be thoroughly cleaned between each mounting.

A very shallow cell of the requisite size is now made upon a slide, and when thoroughly dry one of the charged cover-glasses is taken in the forceps and placed upon the cell, with the diatoms of course next to the slide: it is then pressed down so as to make it adhere. Any pressure must be applied to the part immediately above the ring of the cell. It may then be put aside until a number are ready for being finished upon the turntable, by having a course or two of cement run round the edges, slightly overlapping the edge of the cover-glass. The slide is now duly labelled, and the process of mounting is finished.

Mounting in a Medium.—The object of mounting in a medium is by embedding the diatoms in a substance of a higher refractive power than that of the silex of the diatom to bring them into greater relief under the microscope, and thus to show their details more clearly. There are a large number of mounting media. I have used Canada balsam, styrax, glycerino-gelatine, cassia oil, and a solution of aniline and sulphur. Of all these I prefer the Canada balsam or the styrax, and as the styrax is of a somewhat higher refractive index I generally use it.

Styrax is the natural juice of the Styrax orientalis, a tree of Asia Minor. It is best to purchase it ready prepared. My preparation was obtained from Messrs Rousseau et Fils, 42 Rue-des-Ecoles, Paris. A small quantity of it lasts a long time. The only objection to it is its dark brown colour, but in the thin layer which is necessary this is not at all harmful. It is diluted to the consistency of a thin syrup by pure benzole.

The process in this mounting is the same as in the preceding, up to the point where the diatoms are left dry upon the cover-glass. A drop of benzole is then put upon them which spreads over all, fills the crevices, and thus expels the air. Before it has dried, sufficient styrax to cover the diatoms with a thin layer is dropped upon them. The cover-glass is now left under the bell-glass from twelve to twenty-four hours, according to the time at your disposal. This allows the benzole to evaporate. When you are ready to put the cover-glasses on to the slides the slides are arranged on the mounting-plate, the cover-glasses are taken up in the forceps and placed one by one upon their respective slides, with the styrax face of course downwards. The spirit-lamp is now lit and the plate gently heated, when the styrax will spread in an even layer under the cover-glass. As the cover-glass has a tendency to slip to one side it must, by delicate manipulation, be kept in the centre of the slide. The slides are now laid aside to cool, when a ring of cement may be run round the edge, and after the slide is duly labelled the mounting is complete.

Mounting selected Diatoms.—To some this mode of mounting has great fascination. It requires a steady eye, a firm hand, and above all great patience. One of the most celebrated mounters by this mode was the late Herr J. D. Möller, Wedel in Holstein. His "Typen-Platten" are famed, many hundreds of diatoms being arranged on one slide; on the one in my possession there are upwards of 400. The substance he used as a fixative was, I understand, kept a secret. His mounting medium was monobromide of naphthalin, which has a high refractive index.

The most accomplished mounter of my personal acquaintances is the Rev. Dr Davidson, minister of the parish of Logie-Coldstone, whom I have before mentioned in connection with this study. The most essential thing is to get a good fixative for the diatoms. As I have said, that used by the late Herr Möller is not generally known. The following may, however, be used with advantage: White shellac dissolved in pyroligneous spirit to a thin solution and then filtered. A very small quantity of this is spread by means of a clean quill in the centre of the cleaned cover-glass which is to receive the diatoms, and allowed to dry. This cover-glass, with the smeared side uppermost, is placed on a slip of glass, to which it may be made to adhere by a small quantity of moisture under it. It is then placed under the mounting microscope. On the same plane on the glass slip is placed a drop of the cleaned diatoms to be selected, and beside it a drop of distilled water. With a bristle from a cat's whisker cut to the requisite degree of firmness, and fastened in a quill, the diatoms selected under the mounting microscope are separated from the mass and transferred to the drop of distilled water to be thoroughly washed and freed from all extraneous matter. When cleaned they are pushed to the side and allowed to dry.

One by one they are then picked up on the point of the bristle, and transferred to position on the shellac on the cover-glass. It will facilitate their placing on the shellac if it is slightly moistened with a solution of petroleum and benzole. When the design is completed the cover-glass is removed with the utmost care—preferably by gently pushing always on the same plane—to the mounting-plate, which is slowly heated by the spirit-lamp. The shellac is softened, and the diatoms placed on it adhere. When cool they are mounted in balsam or styrax on a slide in the usual way. The whole process is very trying, especially if elaborate designs are attempted, and I would not advise it to be long continued.

Examination under the Microscope.

The mounting is the last stage preparatory to the examination of the diatoms under the microscope. To provide object-glasses for this examination the highest skill of the optician has been called into requisition, and it is not too much to say that the study of diatoms, more than any other single class of objects, has been the cause of calling into existence the present high class object-glasses. A prepared slide is placed on the stage of the microscope, the lamp is arranged, and if this can be done so that the flame will shine directly, without the intervention of the mirror, into the sub-stage condenser, so much the better. When a sharp bright light is required it is best to use the narrow edge of the flame. The sub-stage condenser is now focussed so that a sharp image of the lamp flame is projected upon the object. An object-glass of power and aperture sufficient to catch up the details of the diatom is put on the microscope, and the examination is begun. In this examination do not be discouraged although things do not come up to your expectation. Beginners usually have exaggerated notions of what is to be seen under the microscope. When we consider the great range of difference in the fineness of the striation of diatoms, we will easily understand there are difficulties to be overcome before all the details are seen. For instance, a Navicula lata, with its robust costæ of 7000 to 8000 in the inch, is easily resolved with an object-glass of numerical aperture of ·30; while the Navicula rhomboides, with its 85,000 striæ to the inch, requires an aperture of at least ·90. I have not succeeded in resolving these lines with a dry object-glass. I have done so with Beck's one-tenth water immersion. Then again there is the Amphipleura pellucida, which I have succeeded in resolving only with Zeiss's one-twelfth homogeneous immersion of 1·30 numerical aperture.

It may be desirable that I should name a few books which would be found useful in the study of the Diatomaceæ. The principal works in English are—

Smith (Rev. W.) Synopsis of the British Diatomaceæ, with Remarks on their Structure, Functions, and Distribution; and Instructions for collecting and preserving Specimens. 2 vols. With 58 plates. Published in 1853 and 1856.

Donkin (Arthur A. S., M.D.) The Natural History of the British Diatomaceæ. Parts 1, 2, 3 (all published). 12 plates. 105 figs. of Navicula. 1871-73.

O'Meara (Rev. E.) Report on the Irish Diatomaceæ. Part 1 (all published). With 9 plates. 1876.

Challenger Expedition—Report on the Diatomaceæ. Prepared by Count Castracane. 30 plates. 1886. This report deals principally with diatoms found in eastern seas.

Wolle (Rev. Francis). Diatomaceæ of North America. With 112 plates and 2300 figs. 1890.

Van Heurck (Dr Henri). "Traité des Diatomées." Published in English, 1896. This is a very important work. An improved edition in French, of a limited number of copies, to subscribers, is in the press, and is expected to be ready by June of this year.

The same author published in 1880-84 his "Synopsis des Diatomées de Belgique," consisting of an Atlas of 132 plates, the "Texte" of 235 pages, and a "Table Alphabetique" of 120 pages. These are in French.

Pelleton (Dr J.) Les Diatomées. 2 vols. 465 figs in the text, and 7 plates. 1888-89. These are also in French.

In German there are many works published. I need only mention the following:—

Kutzing (Dr F. T.) Die kieselschaligen Bacillarien oder Diatomeen, 30 plates. 1844. And the celebrated "Atlas der Diatomaceen-Kunde" of Schmidt, commenced in 1874 and still being continued.

In 'Le Micrographe Préparateur' for November-December 1897 there is an important announcement of the publication of a "Catalogue général des Diatomées," by M. Maurice Peragalo, intended to replace the catalogue of Habirshaw. This will be an almost indispensable work to all who wish to engage in the systematic study of the Diatomaceæ.

X.—*THE UPPER ELF LOCH, BRAIDS.*

[Second Paper.]

By Messrs THOMAS SCOTT, F.L.S., and JOHN LINDSAY.

(*Read March 23, Revised to April 30, 1898.*)

In continuation of our investigations with regard to the micro-flora and the micro-fauna of the Upper Elf Loch, we now beg to submit to the Society this second, and concluding, report, the result of gatherings taken at six different dates since the close of our first paper—viz., June 26, July 27, September 11, and November 20, 1897; February 5 and April 23, 1898. Appended to this paper will be found a list, arranged alphabetically, of the motile Algæ, Desmids, Diatoms, Rhizopods, Infusoria, Rotifera, and Entomostraca observed in the gatherings taken throughout the whole period of these investigations, from March 1896 to April 1898. These groups have been selected because they include many and varied forms interesting to microscopists; but it is not to be inferred that the list is an exhaustive one, though it is believed to be accurate, as far as it goes.

We shall now proceed to select from the groups above-mentioned any forms collected since the close of our first paper which may seem to call for special notice. Before doing so, however, a few words may be given to a rather remarkable circumstance in the history of this little tarn—viz., the large and rapid increase in the growth of rushes, grasses, and other vegetation, which has lately taken place at the north-west part, being the only portion of the loch to which the public have access. This growth began in the autumn of last year (1897), and continued throughout the winter and following spring, with the result that now the total water area is less by fully a third than it was in the spring of 1897. The loch is never cleaned out, and all that keeps rank vegetation in check is the rigour of winter, which usually cuts down much of the growth made during the previous season. The weather in this city, from the middle of

October last to the beginning of February in the present year, was abnormally mild. According to Mr R. C. Mossman, on the 16th of October 1897 one of the most noteworthy bursts of autumnal warmth ever recorded in Edinburgh set in. Mild weather continued to prevail throughout November; and although there was a cold "snap" in December, high temperatures again prevailed, continuing throughout January—the mean temperature of that month being 44°·6, or 7°·8 in excess of the average January temperature deduced from the records of the last 134 years. That the filling up of a considerable portion of the loch by aquatic vegetation was, to a large extent, due to these favourable weather conditions, there can be little doubt. Whether it may ever again assume its former dimensions is very doubtful; indeed, the silting-up process is more likely to go on apace. A very interesting view of the loch, from a photograph taken by Dr Davies in the spring of this year (1898), is here given, showing the growth of vegetation at the north-west part.

We looked forward with considerable interest to the effect of the past mild season on the inhabitants of the loch with the advent of spring; but by the beginning of February frost had set in, and at our visit on the 5th of that month the tarn was covered with a thick coating of ice, which had to be broken in order to permit of a gathering being made. Life, however, even under these adverse conditions, was found to be abundant. Hundreds of caddis-worms were busy constructing their tiny dwellings; beetles and curious-looking larval forms were largely in evidence; entomostraca were particularly lively and numerous; while desmids and diatoms, with a few of the motile algæ, were observed. That all had been stirred into unwonted animation by the mildness of the winter was very evident.

Before leaving this February gathering, some interesting "finds" then made may be briefly referred to. The first was a Water Boatman (*Notonecta glauca*), which had attached to the hinder part of its body a large number of young ostracods (*Cyclocypris serena*). The problem remains whether these ostracods were parasitic at this stage, or whether they had become attached to the beetle accidentally. We are not aware of such a case having been recorded. Another curious

THE UPPER ELF LOCH, BRAIDS.

circumstance was the occurrence in the gathering of certain Entomostraca studded with an Epistylis—a ciliate infusorian allied to Vorticella. Of this remarkable combination there were numerous examples. The crustacean most particularly favoured in this respect was Cyclops strenuus, one of the species possessing long seventeen-jointed antennæ; and the infusorian clustered upon these antennæ from end to end, besides clinging to each side of the copepod's body, and even to the extremity of its long forked tail. Epistylis differs from Vorticella in being branched, with the calyces borne on short, non-contractile stalks; and it was a remarkable sight to witness a Cyclops with a hundred or more of these infusorians attached to it, while the young free-swimming "buds" of the Epistylis revolved round the crustacean. This case is not an uncommon one, the conditions requisite for its production being a shallow piece of water with a quantity of decayed or decaying vegetable matter covering the bottom. The infusorian thus readily joins itself to the crustacean, and neither seems to suffer from the strange "attachment." The Epistylis so attached was E. anastatica; but another species, E. leucoa, was found on a water-bug, as well as on the unprotected portion of the body of a caddis-worm.

The only addition to the filamentous algæ during the past year was Draparnaldia glomerata, which was rather scarce,—indeed, with the exception of two or three of the commoner species of Spirogyra and Oscillaria, the members of this group are conspicuously absent in the Elf Loch. It is otherwise, however, with the motile or unicellular algæ, which are fairly abundant numerically, though not generically. Yet Volvox globator was not nearly so plentiful in 1897 as in the year previous; while in the present year, so far as yet observed, it is still scarce. This interesting alga is rather mysterious in its appearances and disappearances, and it almost seems as if some phases in its life-history were not yet perfectly understood. Our knowledge of the whole group of the motile algæ, indeed, is still in a very unsatisfactory condition. Saville Kent, in his 'Manual of the Infusoria,' regards Pandorina, for example, as synonymous with Eudorina; while Uroglena, Syncrypta, and some others, are said by him to be probably stages of development of Volvox or Pandorina. Some progress towards more exact knowledge has been made in recent years, though much yet remains to be done in this interesting field of study; and the worker in it will usually find abundant material in the Upper Elf Loch.

The Desmids have been increased during the past year by some additional forms, bringing up the list to eight genera and fifteen species. Three fresh species of Closterium were found, two of Cosmarium, and one each of Arthrodesmus, Pediastrum, and Ankistrodesmus, the last often now included amongst the Palmellaceæ. A few Diatoms have also been observed, including two species of Stauroneis and two of Navicula, with one species each of Pinnularia, Gomphonema, and Cymbella. The semi-stagnant condition of the water in this tarn no doubt accounts for such a paucity of Diatoms.

Coming to the unicellular Infusoria of the Animal Kingdom, we are met at the threshold by a similar state of matters to that which still prevails amongst the single-celled plants, seeing that "many of the reputed Infusoria may be but larval forms of higher organisms, instead of being themselves complete animals."[1] This group also furnishes a most interesting study for the microscopist, with its varied and beautiful forms, and its numerous problems still awaiting solution. No fewer than sixty-two species of Infusoria from this little hill-tarn have now been identified for us by Mr John Hood of Dundee, and forty-four of these have been added during the past year. Amongst the latter are three species belonging to a class not represented in our former paper—viz., the Tentaculifera or Suctoria. One of these, the "hairy-backed animalcule" (*Chœtonotus larus*), is here included in this class, though some writers relegate it to the Turbellaria, and others to the Rotatoria, of which they regard it as an aberrant form. A very good description of Chætonotus, with figures, is given in the well-known 'Marvels of Pond-Life,' by Henry J. Slack, F.G.S.

While the Upper Elf Loch is thus abundantly supplied with representatives of the Infusoria, the members of the Rotifera present in it are yet more numerous. During the past year the following accessions have been made to their number. In the 1st order, the *Rhizota*, four additional species have been observed,—

[1] Carpenter's 'The Microscope and its Revelations,' 7th ed., p. 679.

the Beautiful Floscule (*Floscularia ornata*); two of the Tube-dwelling Rotifers (*Melicerta ringens* and *M. tubicolaria*); and what has been described as "perhaps the most beautiful of all the rotifers," Stephanoceros Eichhornii—a very rare rotiferon in Scotland. The 2nd order, the *Bdelloida*, has been increased by seven species; whilst the 3rd order, the *Ploïma*,—the largest of all,—has had no fewer than sixty-six species added to it—making in all a record of ninety-seven species. Though none of these species are new to science, several of them are very rare. We are much indebted to Mr John Hood for his invaluable aid in the identification of the Rotifera,—a group with which he is so well acquainted. We have been favoured with the following notes by Mr Hood on three of the species enumerated in our list. The first refers to Euchlanis propatula (No. 48 of list), regarding which Mr Hood writes as follows:—

Mr Gosse was the first to describe this species (in 'The Rotifera, or Wheel-Animalcules,' vol. ii. p. 87), by the name of Diploïs propatula, illustrated by two figures, a dorsal view and a lateral one. The dorsal view is a very good likeness of the creature, and a sufficient guide to its identity; but, on the other hand, the lateral view is very unsatisfactory, and not at all like it. It has been subsequently described by Dr Burn and Mr Bryce at its proper place in the genus Euchlanis. Its generic characters are undoubtedly those of a Euchlanis. Its ventral plate is a little larger than the dorsal one, which is quite the reverse of all the other species of the genus; but, notwithstanding this, the jaws, internal organs, and foot are those of a Euchlanis.

The next note refers to Salpina marina (No. 90 of list), which certainly calls for some explanation, as occurring here in a fresh-water loch. Mr Hood says:—

Mr Gosse has doubtless erred, at p. 39 of the Supplement to his monograph on the Rotifera, in placing this as a marine rotifer. The only example he described from was a dead one he found in a tube of water from the Firth of Tay which I sent him in 1886, and which contained Notholca spinifera and a few other marine forms. I have no doubt this Salpina had been introduced accidentally into the tube by me—possibly it had been in the dipper when I filled the tube with marine forms. I have never myself found a Salpina in a marine habitat.

The last note is on Triphylus lacustris, Huds. (Furcularia lacustris, Ehr.), (No. 97 of list), regarding which Mr Hood writes:—

This species has only recently been found in Britain. Dr Hudson placed it in a genus by itself, as it was not a Furcularia (in his Supplement to 'The Rotifera,' p. 19). It is a large and handsome species. Mr Western has found it in England, and I have found it in Scotland and in Ireland.

The mites are a group of the Arachnida, to which, unfortunately, very few workers devote themselves. Several genera and species are present in this sheet of water, but we have been unable to identify some of them. In two gatherings taken during the last year, a few specimens of a male or tailed swimming mite were found. The male mites are as rare as are the male Daphnias, to be afterwards referred to, amongst the Entomostraca; and they are, besides, so different in appearance from the round or female mites, that it is extremely difficult to pair them. The male mite found belonged to the Arrenuri (*Arrenurus buccinator*), and was a beautiful creature —the body blue, with tail yellow, shading off to deep orange, and the eyes bright vermilion. The spur on the last joint but two of the hind legs, characteristic of the male, was very large. The motions of the mites in the water are even and graceful,—very unlike the jerky movements of the water-fleas, for example. It may be added that an insect found in the loch, or rather on its surface, which was very plentiful in some seasons, was the Common Water Spring-tail (*Podura aquatica*).

The study of the crustacean inhabitants of the Upper Elf Loch has proved very interesting. The following brief summary shows what has been done, and the results that have been obtained, in the course of our study of these organisms. Of the series of gatherings collected, twelve have been examined for crustacea. Four of these gatherings were made in 1896—in March, May, July, and October; six were collected in 1897—in March, May, June, July, September, and November; while in the present year (1898) one gathering was taken in February and another in April. The total number of crustacean species that have been obtained from these twelve gatherings is thirty-two. Sixteen species, or half of the total number, belong to the Copepoda, five to the Ostracoda, and eleven to the Cladocera. The Copepoda belong to two distinct groups—viz., the Cyclopidæ and the Harpacticidæ. The first is represented by nine and the second by seven species. No representatives of either the Amphipoda or Isopoda have been observed, though both *Gammarus pulex* and *Asellus aquaticus* are frequent enough in other parts of the Edinburgh district.

The greatest number of species observed in any single gathering was twenty-five; this gathering was collected in September 1897. The smallest number — twelve — was observed in a gathering collected in May 1896. Five species of the Entomostraca have been observed in every one of the twelve gatherings examined: the names of these species are—*Cyclops viridis, C. bicuspidatus, Canthocamptus staphylinus, Cyclocypris serena,* and *Candona candida.* Two species—*Cyclops strenuus* and *Simocephalus vetulus*—were observed in ten of the gatherings. Three species—*Cyclops serrulatus, Alona quadrangularis,* and *Chydorus sphæricus*—occurred in nine gatherings. *Attheyella pygmæa, Cypria ophthalmica, Daphnia pulex,* and *Alonella nana*—four species—were obtained in eight gatherings. *Attheyella crassa* and *Alona guttata* occurred in seven gatherings, *Cyclops albidus* and *Cypris fuscata* occurred in six, and *Ilyocryptus sordidus* in five. *Cyclops vernalis, C. fimbriatus, Moraria Anderson-Smithi,* and *Graptoleberis testudinarius* were observed in four gatherings; while *Canthocamptus minutus* was obtained in three. The following eight species were each observed twice—viz., *Cyclops fuscus, C. affinis, Canthocamptus inornatus, Attheyella Zschokkei, Pionocypris vidua, Ceriodaphnia reticulata, Alona costata,* and *Chydorus barbatus.*

With regard to the seasonal distribution of the Crustacea the following points may be noted. It has been already stated that five of the species obtained in the loch occurred in every one of the twelve gatherings examined. These gatherings were collected under very varying conditions of weather and temperature, as well as at different seasons of the year—for example, during the heat of midsummer, when the little loch was much contracted by drought and largely overgrown with vegetation; during the late autumn, when it was filled to overflowing with the autumnal rains and when the vegetation had to a considerable extent disappeared; and also during winter, when the only way in which a gathering could be taken was by breaking the ice that covered the surface of the water, to allow the hand-net to be introduced and worked underneath it, the ice at the time being fully half an inch in thickness. These five species may therefore safely be regarded as permanent inhabitants of the loch. Moreover, it will be observed that several other species have been obtained so frequently that they also may be expected to occur more or less constantly all the year round, and their absence from some of the gatherings may in some instances at least be accounted for by their being overlooked. But, on the other hand, though the non-occurrence of some species may be accounted for in this way, the intermittent appearance of others seems to require a different explanation. There are, for example, a few species, such as *Cypris fuscata* and *Graptoleberis testudinarius*, that appear to have a more or less regular seasonal increase and decrease. *Cypris fuscata* has been observed in spring and early summer, sometimes in considerable abundance: it was obtained in March and October 1896, in March and May 1897, and in February and April 1898, but we failed to observe it on the 9th of May and the 18th of July 1896, as well as on our visits in June, July, September, and November 1897. *Graptoleberis testudinarius* differs somewhat from *Cypris fuscata* in its seasonal distribution. It was obtained in May and July 1896, and in July and September 1897, while no trace of it has been observed during the colder months. Another example of difference in seasonal distribution may be referred to, but in this case the difference is between species much more closely related to each other than *Cypris fuscata* and *Graptoleberis testudinarius*. *Daphnia pulex*[1] and *Simocephalus vetulus*, which are both found in the Elf Loch, are so nearly related that they were formerly considered to belong to the same genus. In the gathering collected on the 9th of May 1896, *Daphnia pulex* was common, but *Simocephalus vetulus* was rare. In the gathering collected on October 17th of the same year, *Daphnia* is again predominant, and is recorded in our notes

[1] The *Daphnia pulex* found in the Upper Elf Loch is usually furnished with a moderately long and slightly curved posterior spine: this form has been described as a distinct species, under the name of *Daphnia Schœdleri*, but it is now regarded as merely a variety of *Daphnia pulex*. What is considered as the typical form of *D. pulex* has no elongate posterior spine, but the test terminates in an acute point. Like other *Daphnias*, it is extremely variable.

as "frequent," while *Simocephalus* is described as "few." When, however, the records of the gathering collected on the 26th of June 1897 are examined, it is found that *Daphnia* is now in the minority, and is described as "rare," while *Simocephalus* is "frequent." On the other hand, both species, in the gathering collected in February last (1898), are described as "rare." In addition to this apparently alternating increase and decrease in the numbers of certain species—an alternation which is probably due to seasonal variation—another interesting feature in the distribution of the Entomostraca has been observed, which it may be worth while to notice here. It was stated in our preliminary report, published last year, that a somewhat rare copepod known as *Moraria Anderson-Smithi* had been obtained in the Upper Elf Loch. The first time this copepod was observed here was on October 17, 1896: it was again noticed in the gatherings collected on March 6, May 1, and June 26, 1897, but though it has been carefully searched for in subsequent gatherings, no trace of it, alive or dead, has been found. We cannot ascribe the disappearance of the copepod in these subsequent gatherings to any difference in the mode of collecting them, for the same method has been as far as possible adhered to throughout the whole series of visits we have made to the loch; and, on the other hand, we would hardly venture to assert that because we had not found this species in these gatherings it had therefore become extinct; but we think it is quite safe to say that, if it still exists in the loch, it must have become exceedingly rare. Moreover, if the appended tabular list of the Entomostraca obtained in the Upper Elf Loch, be examined it will be further observed that, shortly after the disappearance of *Moraria Anderson-Smithi*, another comparatively rare copepod—*Canthocamptus inornatus*—was obtained for the first time. This species, which occurred in the gathering collected on September 11, 1897, had only a few months previously been described by one of us as new to science, from specimens found in a loch in Forfarshire, and also in Linlithgow Loch. How this species happened to be introduced into the Upper Elf Loch, or, if usually present there, how it came to be so long overlooked, are questions more easily asked than answered. *Canthocamptus inornatus* is rather a distinct and readily recognised form, and was not at all rare in the September gathering referred to; yet, strange to say, the only time it has with certainty been noticed since was in the last gathering of the series, collected on the 23rd April last, when only one or two specimens were obtained. It may be stated in passing that *Canthocamptus inornatus* has also been recently, and for the first time, observed in Duddingston Loch.

These, then, are a few of the facts bearing on the distribution of the Entomostraca which our examination of this miniature loch has brought to light. They indicate how much interesting information a regular and systematic research, even of a very limited area, may yield. The curious, and apparently erratic, appearance and disappearance of the species we have specially referred to explains also to some extent why one collector may be more successful than another, or why the same collector may obtain a richer gathering at one time than at another.

As the study of the Entomostraca is now receiving greater attention, and many microscopists and pond-workers are doubtless desirous of becoming more familiar with them, the following notes on their reproduction may be of some little value to such amongst our own members. The reproduction and life-history of the Entomostraca have long engaged the attention of naturalists, and are still subjects of considerable interest to students of these crustaceans. The Cladocera, one of the more important orders of the Entomostraca, is of special interest, because of the peculiar reproductive processes observed in several of the groups composing the order. Most part of the Cladocera are fresh-water organisms: a few of the genera, however, are marine, and species belonging to these marine genera are sometimes observed in immense numbers, so that the lack of variety in marine forms, as compared with those inhabiting the fresh waters, is somewhat compensated for by the greater number of individuals that are occasionally met with.

All, or nearly all, the fresh-water Cladocera produce two kinds of "eggs"—viz., summer eggs, and winter- or resting-eggs. The summer eggs are considered to be, *not* true eggs, but "buds," and they have received the name of "pseudova."

In some of the Daphniadæ, and perhaps also in some of the other groups, broods of these pseudova are produced at more or less frequent intervals, and sometimes in considerable numbers during the life of the female; but in most of the Lynceidæ the production of summer eggs does not appear to be so frequent or so numerous. The winter- or resting-eggs —the latter name, as will be apparent from what follows, is the more appropriate one—are said to be true fertilised eggs, and they are produced usually towards the close of the life of the female, their production being her last efforts for the propagation of the species. In the Daphniadæ, and probably also in the Lynceidæ,—certainly in some of them,—these resting-eggs are enclosed in a portion of the test of the mother that is somewhat modified for the purpose, and is technically called the ephippium (Gr. *ephippion*, a saddle, from its shape). Speaking generally, two resting-eggs are produced in the Daphniadæ, but only one in the Lynceidæ. These eggs appear as dark-coloured, or almost black, oval bodies, within the ephippium. The production of the ephippia is not limited to autumn or winter, as they may be produced at any season, just as the so-called summer eggs may be observed at all seasons—in winter as well as in summer. Resting-eggs, after being set free, and whether enclosed in a true ephippium or not, may, and frequently do, lie dormant for a considerable period, hence the name "resting-eggs." It is doubtful if the causes that in due time excite the active development of these resting-eggs are yet clearly understood: increase of temperature may have something to do with it. Ephippia enclosing one or two eggs are often met with by the pond-worker, and occasionally prove a source of perplexity: it is therefore hoped that what has just been stated as to their true character may prove useful to some.

Another interesting feature in the history of the Cladocera is the entire absence, or extreme rarity except at irregular and more or less distant intervals of time, of the males of many of the species. The Daphniadæ may be referred to as furnishing examples of this phenomenon. The female Daphnia is frequently very prolific. She may develop brood after brood of young at short intervals for a considerable time, and these young, in their turn, may give birth to other young for several generations, while all the time not a single male may be observed. For this reason the female Daphnia has been regarded as parthenogenetic. The appearance of the males is not only irregular, but is also not limited to the autumn and winter months, as some have supposed. As a matter of fact, we have obtained them in July as well as in December, and they were even more numerous in the warm than in the cold months.

The young Entomostracan is usually very different in appearance from the adult, but in some groups the difference is less apparent than in others. One of the most interesting groups, in this respect, is that of the Daphniadæ, as some of them, and Daphnia especially, are subject to so much variation that there is still considerable doubt as to which are species and which mere varieties. Development and environment appear to have a modifying influence on the form of the Daphniæ, and even in some degree on their structure also, to a greater extent than on almost any of the other groups. It will thus be seen that the study of the Entomostraca, like so many of the other departments of nature, has its own difficulties and interesting problems, for the elucidation of which patient workers in larger numbers are needed.

In bringing these investigations to a close, we desire to emphasise the benefits to be derived from a *continuous* examination of a particular loch or pond. When such an examination is carried on throughout a whole year, or longer, not only seasonal variations may be noted, but the various phases in the life-history of a minute plant or animal come under one's observation, the cycle of growth and development is usually completed, and a more or less intelligent conception is gained of the various complex stages through which many, if not most, of these lowly organisms pass. That there must be a material gain in such a mode of procedure is evident. Patient observation of the processes of nature, as these go on silently around us, has its valuable uses, not to speak of its fascinations. In such a humble task as the repeated examination of even a hill-tarn, lessons can be learnt which may help to unlock some secret of nature never yet yielded up.

MICRO-FLORA AND MICRO-FAUNA OF THE UPPER ELF LOCH, BRAIDS.

ALGÆ.

Coccophyceæ.

Volvocineæ.

1. Chlamydococcus pluvialis, Cohn.
2. Gonium pectorale, Ehr.
3. Pandorina morum, Bory.
4. Stephanosphæra pluvialis, Ehr.
5. Volvox globator, Ehr.

Zygophyceæ.

Desmidieæ.

1. Ankistrodesmus falcatus, Ralfs.
2. Arthrodesmus octocornis, Ehr.
3. Closterium didymotocum, Corda.
4. " Ehrenbergii, Menegh.
5. " lineatum, Ehr.
6. " lunula, Ehr.
7. Cosmarium botrytis, Menegh.
8. Cosmarium cristatum, Ralfs.
9. " margaritiferum, Turp.
10. Euastrum didelta, Ralfs.
11. " oblongum, Grev.
12. Pediastrum De Barzanum.
13. " selenæum, Kutz.
14. Scenedesmus quadricauda, Breb.
15. Spondylosium pulchellum, Archer.

Schizophyceæ.

Diatomaceæ.

1. Cymbella gastroides, Ag.
2. Diatoma elongatum, Ag.
3. " vulgare, Bory.
4. Gomphonema geminatum, Ag.
5. Navicula maxima, Ehr.
6. " Pinnularia major, Ehr.
7. Pinnularia viridis, W. Sm.
8. Stauroneis acuta, Ehr.
9. Stauroneis pulchella, Ehr.

PROTOZOA.

RHIZOPODA.

Amœbea.

1. Amœba princeps, Ehr.
2. " proteus, Leidy.
3. " radiosa, Ehr.
4. Amœba Schultzii, Ehr.
5. Difflugia globulosa, Duj.
6. " pyriformis, Perty.

INFUSORIA.

I. Ciliata.

1. Amphileptus gigas, C. & L.
2. Aspidisca costata, Duj.
3. Carchesium polypinum, Linn.
4. Coleps hirtus, Ehr.
5. Colpidium cucullus, Schrank.
6. Epistylis anastatica, Linn.
7. " flavicans, Ehr.
8. " leucoa, Ehr.
9. Halteria grandinella, Müll.
10. Holophrya ovum, Ehr.
11. Kerona polyporum, Ehr.
12. Loxophyllum meleagris, Ehr.
13. Onychodromus grandis, Stein.
14. Oxytricha fallax, Stein.
15. Paramœcium aurelia, Ehr.
16. Paramœcium bursaria, Ehr.
17. Prorodon niveus, Ehr.
18. Stentor igneus, Ehr.
19. " polymorphus, Müll.
20. Stichotricha remex, Huds.
21. Strombidium Claparedi, Kent.
22. Stylonychia mytilus, Ehr.
23. Trichodina pediculus, Ehr.
24. Uroleptus gibbus, C. & L.
25. " piscis, Müll.
26. Vorticella alba, From.
27. " campanula, Ehr.
28. " communis, From.
29. " nebulifera, Ehr.
30. " nutans, Ehr.
31. Zoöthamnium parasita, Stein.

II. Flagellata.

32. Anisonema grande, Ehr.	43. Euglena spirogyra, Ehr.
33. " ludibundum, Kent.	44. " viridis, Ehr.
34. " truncatum, Stein.	45. Eutreptia viridis, Perty.
35. Anthophysa vegetans, Müll.	46. Lophomonas blattarum, Stein.
36. Chilomonas cylindrica, Ehr.	47. Phacus longicaudus, Ehr.
37. Cladonema laxa, Kent.	48. " pyrum, Stein.
38. Codosiga botrytis, Ehr.	49. " triqueter, Ehr.
39. Dinobryon sertularia, Ehr.	50. Podostoma filigera, C. & L.
40. " stipitatum, Stein.	51. Spongomonas discus, Stein.
41. Dinomonas vorax, Kent.	52. Syncrypta volvox, Ehr.
42. Diplomastix saltans, Ehr.	53. Synura uvella, Ehr.

54. Uroglena volvox, Ehr.

III. Cilio-Flagellata.

55. Gymnodinium roseolum, Sichner.	58. Peridinium apiculatum, Ehr.
56. Mallomonas Plosslii, Perty.	59. " tabulatum, Ehr.
57. Mitophora dubia, Perty.	60. Stephanomonas locellus, From.

61. Trichonema hirsuta, From.

IV. Suctoria.

62. Chætonotus larus, Ehr.	63. Podophrya cyclopum, C. and L.

64. Podophrya fixa, Müll.

METAZOA.

ANNULOSA.

Rotifera.

Order 1. *Rhizota.*

1. Floscularia cornuta, Dobbie.	4. Melicerta ringens, Schrank.
2. " cucullata, Hood.	5. " tubicolaria, Ehr.
3. " ornata, Ehr.	6. Stephanoceros Eichhornii, Ehr.

Order 2. *Bdelloida.*

7. Actinurus neptunius, Ehr.	12. Philodina roseola, Ehr.
8. Callidina bidens, Gosse.	13. " tuberculata, Gosse.
9. " elegans, Ehr.	14. Rotifer hapticus, Gosse.
10. Philodina citrina, Ehr.	15. " tardus, Ehr.
11. " megalotrocha, Ehr.	16. " trisecatus, Weber.

17. Rotifer vulgaris, Schrank.

Order 3. *Ploïma.*

18. Anuræa aculeata, Ehr.	31. Copeus caudatus, Ehr.
19. " brevispina, Ehr.	32. " cerberus, Gosse.
20. " cochlearis, Ehr.	33. " deflexus, Ehr.
21. " serrulata, Ehr.	34. " pachyurus, Gosse.
22. Brachionus angularis, Gosse.	35. Diaschiza exigua, Huds.
23. " arceolaris, Ehr.	36. " Hoodii, Gosse.
24. Cathypna luna, Ehr.	37. " semi-aperta, Gosse.
25. " rusticula, Gosse.	38. " tenuior, Gosse.
26. Cœlopus brachyurus, Gosse.	39. Diglena biraphis, Gosse.
27. " porcellus, Gosse.	40. " catellina, Ehr.
28. Colurus caudatus, Ehr.	41. " giraffa, Gosse.
29. " deflexus, Ehr.	42. Dinocharis pœcillum, Ehr.
30. " obtusus, Gosse.	43. " tetractis, Ehr.

44. Distyla Gissensis, Eckstein.
45. Eosphora aurita, Gosse.
46. Euchlanis lyra, Huds.
47. " oropha, Gosse.
48. " propatula, Bryce.
49. " triquetra, Ehr.
50. Furcularia ensifer, Gosse.
51. " giraffa, Gosse.
52. " gracilis, Gosse.
53. " longiseta, Ehr.
54. Hydatina senta, Ehr.
55. Mastigocerca bicristata, Hood.
56. " carinata, Ehr.
57. " lophoëssa, Gosse.
58. " macera, Gosse.
59. " rattus, Ehr.
60. " Scipio, Gosse.
61. Metopidia acuminata, Ehr.
62. " emarginata, Gosse.
63. " lepadella, Ehr.
64. " oxysternum, Gosse.
65. " solidus, Gosse.
66. Microdon clavus, Ehr.
67. Monostylla bulla, Gosse.
68. " cornuta, Ehr.
69. " lunaris, Ehr.
70. Noteus quadricornis, Ehr.
71. Notholca Leptodon, Spencer.
72. " longispina, Kell.
73. Notommata aurita, Ehr.
74. " lacinulata, Ehr.
75. " ovulum, Gosse.
76. " tripus, Leidig.
77. Pleurotrocha gibba, Ehr.
78. Polyarthra aptera, Hood.
79. Proales gibba, Ehr.
80. " sordida, Gosse.
81. Pterodina patina, Ehr.
82. " valvata, Huds.
83. Rattulus calyptus, Ehr.
84. " cimolius, Gosse.
85. " tigris, Müll.
86. Sacculus cuirassis, Hood.
87. Salpina brevispina, Ehr.
88. " eustala, Gosse.
89. " macracantha, Gosse.
90. " marina, Gosse.
91. " mucronata, Ehr.
92. " spinigera, Ehr.
93. Scaridium eudactylotum, Gosse.
94. Stephanops armatus, Huds.
95. Synchæta tremula, Ehr.
96. Taphrocampa annulosa, Gosse.
97. Triphylus lacustris, Huds.

ENTOMOSTRACA.

I. Copepoda.

1. Attheyella crassa (G. O. Sars).
2. " pygmæa (G. O. Sars).
3. " Zschokkei (Schmeil).
4. Canthocamptus inornatus, T. Scott.
5. " minutus, Claus.
6. " staphylinus (Jurine).
7. Cyclops affinis, G. O. Sars.
8. " albidus (Jurine).
9. " bicuspidatus, Claus.
10. Cyclops fimbriatus, Fischer.
11. " fuscus (Jurine).
12. " serrulatus, Fischer.
13. " strenuus, Fischer.
14. " vernalis, Fischer.
15. " viridis (Jurine).
16. Moraria Anderson-Smithi, T. and A. Scott.

II. Ostracoda.

17. Candona candida, Müller.
18. Cyclocypris serena (Koch).
19. Cypria ophthalmica (Jurine).
20. Cypris fuscata, Jurine.
21. Pionocypris vidua (Müller).

III. Cladocera.

22. Alona costata, G. O. Sars.
23. " guttata, G. O. Sars.
24. " quadrangularis (Müller).
25. Alonella nana (Baird).
26. Ceriodaphnia reticulata (Jurine)
27. Chydorus barbatus (Brady).
28. Chydorus sphæricus (Müller).
29. Daphnia pulex, De Geer.
30. Graptoleberis testudinarius (Fischer).
31. Ilyocryptus sordidus (Liévin).
32. Simocephalus vetulus (Müller).

[Table

TABLE OF SEASONAL VARIATIONS IN THE ENTOMOSTRACA.

SPECIES.	1896.				1897.						1898.	
	March 21.	May 9.	July 18.	Oct. 17.	March 6.	May 1.	June 26.	July 27.	Sept. 11.	Nov. 20.	Feb. 5.	April 23.
I. COPEPODA.												
Attheyella crassa (G. O. Sars)	...	...	...	+	+	+	...	...	+	+	+	+
" pygmæa (G. O. Sars)	...	...	...	+	+	+	+	+	+	(?)	+	+
" Zschokkei (Schmeil)	+	...	...	...	...	...	...	+	...	...	...	...
Canthocamptus inornatus, T. Scott	...	...	...	...	...	...	...	...	+	...	...	+
" minutus, Claus	...	...	...	+	+	+	...	...	...	...	...	...
" staphylinus (Jurine)	+	+	+	+	+	+	+	+	+	+	+	+
Cyclops affinis, G. O. Sars	...	...	...	...	...	...	...	+	...	...	...	+
" albidus (Jurine)	...	...	+	...	...	...	+	+	+	...	+	+
" bicuspidatus, Claus	+	+	+	+	+	+	+	+	+	+	+	+
" fimbriatus, Fischer	...	...	...	...	...	...	...	+	+	+	...	+
" fuscus (Jurine)	...	...	...	...	+	+	...	...	...	...	...	...
" serrulatus, Fischer	...	...	+	+	+	+	+	+	+	...	+	+
" strenuus, Fischer	+	...	+	+	+	+	+	+	+	...	+	+
" vernalis, Fischer	...	...	...	...	+	...	+	+	+	...	...	...
" viridis (Jurine)	+	+	+	+	+	+	+	+	+	+	+	+
Moraria Anderson-Smithi, T. & A. Scott	...	...	...	+	+	+	+	...	...	...	...	...
II. OSTRACODA.												
Candona candida (Müller)	+	+	+	+	+	+	+	+	+	+	+	+
Cyclocypris serena (Koch)	+	+	+	+	+	+	+	+	+	+	+	+
Cypria ophthalmica (Jurine)	...	+	+	...	...	+	...	+	+	+	+	+
Cypris fuscata, Jurine	+	...	...	+	+	+	...	...	...	...	+	+
Pionocypris vidua (Müller)	+	...	...	...	...	...	...	...	+	...	...	...
III. CLADOCERA.												
Alona costata, G. O. Sars	...	...	...	...	...	...	...	...	+	...	...	+
" guttata, G. O. Sars	+	...	+	+	...	...	+	+	+	...	+	...
" quadrangularis (Müller)	+	+	+	+	...	...	...	+	+	+	+	+
Alonella nana (Baird)	+	...	...	+	+	...	+	+	+	...	+	+
Ceriodaphnia reticulata (Jurine)	...	...	+	...	...	...	...	...	+	...	...	...
Chydorus barbatus (Brady)	...	...	...	...	...	...	...	...	...	+	+	...
" sphæricus (Müller)	+	+	...	+	+	...	+	...	+	+	+	+
Daphnia pulex, De Geer	+	+	+	+	...	...	+	+	...	...	+	+
Graptoleberis testudinaria (Fischer)	...	+	+	...	...	...	...	+	+	...	...	...
Ilyocryptus sordidus (Liévin)	...	+	+	...	...	...	...	...	+	+	...	+
Simocephalus vetulus (Müller)	+	+	+	+	...	...	+	+	+	+	+	+
Total number of species observed in each gathering	15	12	16	18	16	14	16	20	24	13	19	22

XI.—*A PET CUCKOO.*

By Mr CHARLES CAMPBELL.

(Read April 27, 1898.)

One day last summer, while in Mr Cochrane's bird-shop in Market Street, Edinburgh, I was surprised to see a cuckoo disporting itself in a cage quite at home. As it has always been a debated question whether a bird with so strong a migratory instinct as a cuckoo could long survive captivity, I was much interested in this specimen, and naturally desirous of knowing something more of its history. There is, of course, a natural feeling against keeping any wild bird in confinement, but, given proper treatment, much that is interesting can be learned from them; and there is surely nothing that can be said against making pets of our own wild birds that does not, in an equal measure, apply to birds imported from abroad.

In August 1894 there was some correspondence in the 'Scotsman' as to the late occurrence of the cuckoo in Scotland, and I then stated I had every reason to believe that in 1892 a belated specimen of the cuckoo was seen in the woods of Morven, Argyllshire, as late as December, the weather being then exceptionally mild in that district. Another correspondent wrote saying he did not believe this, and quoted from Mr Speedy's book, 'Craigmillar and its Environs,' as proving that our climate is incompatible with the existence of the cuckoo in winter. The bird Mr Speedy describes in that book did not survive beyond October, but Mr Cochrane's pet has already survived two winters. In the cold weather it is taken from the shop to Mr Cochrane's house, where I went to see it a few nights ago. When I entered the house the cuckoo was perched on the fender at the side of the fire, quite at liberty. It readily pecked a meal-worm given to it, and exhibited no fear at the presence of a stranger. After a look round at some other pets, I inquired more minutely into the history of the cuckoo. It was taken from a tit-lark's nest in Wigtownshire, and hand-reared. One of the great secrets of success in bird-rearing is, of course, to know the proper kind of food to give, and the cuckoo has an extensive and varied diet. Its staple food, however, may be said to be meal-worms, of which it is very fond. A small piece of raw meat it regards as a delicacy, and in the season it has a little chopped lettuce or some grated carrot made up with meal into a kind of paste, in which there may be also a sultana raisin or two.

Last year the cuckoo moulted in February, and it is in the same condition at present. After it was through the moult last season, much to the surprise of its custodian the cuckoo commenced its well-known call, and continued crying till July. This is a very rare occurrence, and I am not aware of any previous instance where the cuckoo has been known to give voice in captivity. About the end of July it began to exhibit a restlessness it had not previously shown. That it felt the warnings of its instinct impelling it to fly to a more congenial climate was very evident. After a time it quietened down again, and began to moult its feathers a second time.

The cuckoo this year commenced to cry on the 7th of April, exactly one week earlier than last year. The note of the bird was clearer and firmer last season than it has been this. It has never been in a position to hear the note of its wild companions, but has been reared among the shrieks of parrots, the piping of bullfinches, and the trilling of German canaries. On one occasion, when the parrots were screaming in chorus, the cuckoo commenced calling vigorously, and, much to the astonishment of its owner, it soon had the field to itself, for the parrots by common consent seemed to stop and listen. It continued to call on that occasion for nearly ten minutes.

The following extracts regarding the cuckoo in captivity may be of some interest in connection with the bird now exhibited.

Morris's 'British Birds':—

In several instances the cuckoo has been kept, great care being used, throughout the winter—one for nearly two years—and it was then only killed by accident.

Lord Lilford's 'Birds of the British Islands':—

It is difficult, but by no means impossible, to keep the cuckoo in confinement through the winter in this country; but it is not an attractive cage bird, and, in my experience, becomes so restless at the season of migration that, however quiet and tame at other times, it invariably, when urged by the travelling instinct, ruins its plumage and appearance by breaking the feathers of its wings and tail in attempting to escape. The general demeanour of my captives of this species has been sulky, greedy, and spiteful.

[The cuckoo as exhibited at the meeting was in rather poor condition, so far as feathers went, but it was quite healthy, and had a good appetite, as was shown by the greedy manner in which it took some meal-worms given to it. The paragraph in the 'Scotsman' giving an account of this meeting of the Society was widely copied by the provincial press, both in Scotland and England, and Mr Campbell received a large number of letters (addressed to the care of the Secretary) from different parts of the country, desiring further particulars regarding the bird. The editor of the 'Sketch' wrote asking for a photo of the cuckoo, and the illustration duly appeared in that paper on May 30, 1898.]

XII.—*NOTES ON A FEW RARE MOSSES.*

By Mr A. MURRAY.

(*Read April 27, 1898.*)

I DESIRE to say a few words about some important finds in mosses which Mr Charles Scott and I have made. The first I shall mention is the most important of all—Stableria gracile (*Orthodontium*). This moss, as recorded, has only once been found in Scotland before. Hobkirk mentions it as having been found in Yorkshire and Cheshire. Dixon and Jameson says, "A very rare and distinct species, hardly known out of Britain, except in two French localities." Dr Braithwaite gives all the reported localities—Helsby, Frodsham, Alderley

Edge in Cheshire, by Wilson, 1833; Harrison's Rocks, Tunbridge Wells, by Borrer, 1844; The Strid, Wharfedale, by Spruce; West Kilbride, Ayrshire, by Boyle, 1887.

At the excursion of the Society to Rosslyn Glen for Hepaticæ, I must confess I paid more attention to mosses than hepatics, and by doing so had the good fortune to find this rare moss. I did not know the moss when I first saw it, but on Mr Scott coming up, I handed a piece to him, and was very pleased not to hear him name it right off, as he usually does. When next I saw Mr Scott, he told me that he believed the moss to be Stableria gracile, and it was sent away in order to have the name verified.

The next moss I shall notice, Hypnum patientia, is not so rare, but the finding of it in fruit is very uncommon: indeed there is but one record of its being so found, and that was in Western Prussia, by Dr Klengraff—I do not know the date. Dixon and Jameson say: "Found on the ground in woods, on rocks covered with earth, &c., principally on clay; not common. Fruit very rare; not found in Britain." It was by the merest chance that we noticed it. Mr Scott and I were on the Pentlands one Saturday afternoon, about the beginning of March, when he pointed out to me a large bed of Hypnum patientia from which he had pulled a small patch. I likewise pulled a bit, and it was on preparing this for drying that I noticed the fruit-stalks appearing. On mentioning it to Mr Scott, he would scarcely credit it, knowing it to be such a rare fruiter. We thought that we might get a deal of fruit, but, alas! very few fruit-stalks came up, although there were three large beds of it. I think such a find is well worth recording.

My other specimen is Hypnum stramineum. It is also a very rare moss in Scotland. Mr Scott found it on the Pentlands. It is a lovely moss, but a very rare fruiter. I have found a Hypnum in fruit which must be either H. stramineum or the more rare one, H. trifarium: Mr Scott thinks it is the former.

There are several other rare mosses which we have found in the neighbourhood, but these I shall do little more than mention at present, leaving full descriptions for another occasion. First, we got a small piece of Andræa rupestris on the rocks near the waterfall in the Pentlands; and in the burn beside the waterfall Fontinalis squamosa in fine fruit in April; while near the same place was Tortula princeps in fruit, with Barbula fallax above the waterfalls. Mnium subglobosum was gathered by Mr Scott and myself near Swanston in fine fruit: it is a very distinct moss. Another pretty moss, Hypnum cresta-castrensis, is to be found near Balerno Moss. Scarcely any one could pass this plant without admiring it, as it is a large and pretty moss. On Craiglockhart Hill we have gathered many fine mosses, among which were Bryum roseum, Zygodon viridissimus, and Rhynchostegum tenellum, a very small Hypnum.

I think it is to be regretted that so few of the members of this Society make collections of these lovely plants. They take up little space, being mostly small, but they are well worth the attention of any one.

CONVERSAZIONE, AND MICROSCOPIC AND NATURAL HISTORY EXHIBITION.

By Mr Wm. WILLIAMSON.

On 29th October 1897 the Society opened its 30th Session with a conversazione. Owing to the unavoidable absence of the President, the chair was taken by Dr Sprague, ex-President, who, after the reception, gave an address reviewing briefly the great advances which had been made in scientific knowledge since the Society held its last conversazione ten years ago. During the evening Mr T. C. Day gave a series of demonstrations on the X-rays by means of Crookes' tubes and also vacuum tubes which he had made specially for the purpose. The value of the X-rays in surgery was demonstrated when a leaden pellet lodged in Mr Speedy's hand was clearly shown. At the same time Mr Day showed by means of the spectroscope the new gases Argon and Helium, tubes of which had been loaned to us by Professor Ramsay, who is associated with the discovery of these elements. This was the first time that these had been exhibited in Scotland.

The exhibition included Natural History, Geological, and Botanical specimens, and scientific apparatus. A few words may be said about each under their respective headings.

Natural History was represented by live specimens and by prepared specimens. The live specimens included a golden eagle, a fox, and an owl, from Mr Speedy; a frame of bees from Mr A. Murray; cages of birds from Mr Brotherston; and the larger portion of the exhibit under the charge of Captain Turbyne. It is not often that an eagle, an owl, or a fox turns up at a meeting, consequently these came in for a good deal of attention. Those who were engaged in the Hall in the afternoon had an opportunity of seeing the habit of the eagle when feeding, and also of observing the fox. Owing to the numbers present in the evening, the fox concealed itself as much as possible from observation, and so was not seen by every one.

In September 1897, application was made to the chairman of the Committee of the Biological Station, Millport, to allow Captain Turbyne, the curator, to bring exhibits from the Station, and this was at once most cordially granted. The weather being favourable for dredging, Captain Turbyne was able to obtain a number of live specimens for us, and these included a young octopus, starfish, limas, anemones (some of them growing on the backs of crabs), &c. Mrs Robertson of Millport very readily assented to lend some of the specimens of marine algæ collected by herself and the late Dr Robertson. These were brought to Edinburgh by Captain Turbyne, and were, along with the other Millport exhibits, a very great attraction. In addition to the exhibits already enumerated, the frame of bees, and the cages of charming finches, waxbills, weavers, &c., were well worthy of the amount of attention given them.

Prepared Natural History specimens were exhibited by Mrs Carphin, Mr Symington Grieve, and Mr Thomas Scott. Mrs Carphin's exhibit was in the main illustrative of the study of shells, and comprised a large number of British and Foreign shells, as well as fishes, such as Ostracion, Tetradon, Sawfish, &c. Mr Symington Grieve gave us cases of Scottish mammals; while the chief point of interest to the ordinary observer in

Mr Thomas Scott's exhibit was the collection of parasites peculiar to fish, such as cod-lice, eye-suckers, &c.

Botany was represented by the exhibits of Dr Watson, Mr Thomas Wright, Mr Charles Scott, and Captain Morrison. Dr Watson's exhibit was illustrative of the Fungi; while Mr Wright exhibited a collection of specimens of native and foreign wood. Mr Charles Scott gave us specimens out of his large collection of mosses; and Captain Morrison was good enough to lend us, at the request of one of our members, a collection of West Indian ferns (by mistake these were described in the programme as from New Zealand). Both of these exhibits were hung round the walls of the large Hall.

Geological specimens were furnished by Mr J. G. Goodchild and Mr J. A. Johnston, both of whom exhibited a number of specimens of rocks and fossils. Professor Ivison Macadam sent us several cases containing specimens of gold and silver ores, various kinds of coal, &c.; while the Rev. J. H. Lawrie showed a collection of corals along with a number of photographs and native products brought by him from the South Sea Islands, where he had laboured as a missionary for a number of years.

In addition to the foregoing exhibits may be mentioned that of Miss Murray Gartshore, as well as that of Major Grahame, which comprised a number of curios, some of them valuable, acquired during a residence of several years in eastern countries. Mr Goodchild also loaned to us his collection of animal drawings, which were hung on the walls.

The exhibitors in the instrument class were Mr W. C. Crawford and Mr William Hume, along with Mr William Douglas, who exhibited the kromscope, an instrument for obtaining coloured views from photo negatives. Mr Crawford exhibited the apparatus necessary for satisfactory results in the preparation of microscopic slides—*e.g.*, ovens, thermostats, microtomes for embedding and freezing, &c. Mr Hume's collection was of scientific apparatus useful to microscopists.

As is usual at similar meetings held by the Society, there was an exhibition of microscopic preparations by the members. The Programme, giving details of the various exhibits, as also the Plan showing the arrangement of the Hall on this occasion, are inserted opposite.

PLANTS WHICH DISSIPATE ENERGY.

(REPORT FROM THE MICROSCOPICAL SECTION.)

BY MR W. C. CRAWFORD, M.A., F.R.S.E.

THE object of this report, like that of last year, is an attempt to arrive at some generalisations from the facts we have studied in the Microscopical Section during the winter. Have our studies thrown any light on the wider problems which, as field-naturalists, we have always in our minds?

If I lift a book from the floor and place it upon the table, I have given the book (as every one knows) a certain amount of energy, a certain power of doing work which it did not possess when it lay on the floor. Instead of being a book, if it were a weight it might drive a clock for a week in consequence of being so raised. When the clock weight is pulled up, energy is stored; when it runs down, the stored-up energy is turned into motion. Now, there are two kinds of very simple plants: the one kind stores up energy—these are the green plants; the other kind uses the energy which has been stored up—these are the moulds and the yeasts and the mushrooms.

During the winter before last this Section occupied itself with the study of the cell which stores up energy—the green cell. We studied then the algæ: during the present winter we have been studying cells which run down energy,—cells without chlorophyll,—the fungi. These are the two simplest of plant forms, and from their very simplicity we can discover much about the fundamental conditions of life which the study of the higher forms would not reveal.

We began our studies naturally with the moulds, and we cultivated them on hanging drops. If we want to understand an organism we must try to grow it. We all, whether we know it or not, carry the spirit of the gardener into the regions of thought, for evolution means the continuous growth of something, be it an organism or a system or a society. So in growing our moulds we lost much time, but I hope that we learned something. We wanted to get the very commonest of moulds, one known to every gardener, the cause of the damping-off of seedlings; and we sowed cress in the orthodox fashion and kept it closely covered with a bell-jar, and the moisture hung like dew for weeks on the little plants, but no fungus appeared. We repeated this, and I looked through several greenhouses and could find no damping-off; evidently there were few Pythium spores in the air here last winter. Then we wanted to get zygospores, and we put bread and jam in covered moist dishes: we got plenty of mould, but no conjugation. We consulted our books. One distinguished author explained the matter so far: he said that conjugation takes place at the end of summer only. Zygospores are furnished with a thick coat, which can long withstand the inclement season. That seemed a satisfactory explanation. What was much more interesting was, that by following Klebs' recent researches conjugation could be brought about at will. Moulds can be made to reproduce themselves vegetatively or sexually by keeping them at different temperatures. When moulds are grown about 28° C., zygospores appear in a very short time. This physiological effect of a considerable rise of temperature is of great interest. It has a parallel amongst the green algæ. Take a handful of the tiny green threads which grow in every clean pond or in the ditch at the side of every country road. You will probably find amongst them Spirogyras or Vaucherias in abundance. When in their native home they will most likely be growing vigorously—they will be in a simply vegetative condition; they have abundance of air and sunshine, and are kept in continual gentle agitation. Place them in an aquarium or a tumbler (preferably at a north window); they will continue to grow, but the conditions are changed. They are no longer in a cool, well-aired stream, carrying a good deal of carbonic acid and mineral matter; they have been transferred to a stagnant pool, fanned by no breezes and subject to great changes of temperature, and as the conditions are the same all through our vase, an epidemic of conjugation takes place. These are illustrations of how change in the environment acts immediately on the organism.

In studying the lower fungi—the moulds—we cannot but be struck with the great similarity of form that exists, particularly in reproduction, between the green algæ and the moulds. Compare a Vaucheria with a Pythium, a Spirogyra with a Mucor [slides of these were shown under the microscope]. It may be asked, How has that extreme likeness of form arisen, associated with an enormously great difference in habit? We can imagine how in all probability the transformation took place. Look at a Spirogyra filament going to fruit: some cells of the filament may be found dead and quite empty, and others living and apparently healthy. The contents of the empty cells have evidently gone to nourish the living cells, and so the saprophytic habit has been initiated. We may support the guess by experiment. Put some filaments of green alga in a weak solution of sugar in darkness, and they will grow for some time: the alga lives temporarily like a saprophyte.

Last year we saw good reason to conclude from our study of algæ that sex had its origin in a union of two or more little cells to increase the mass of the new individual—to increase its vital capital; and we saw that sex was developed and specialised more and more by adversity. In the great uniform ocean the green seaweeds are mostly asexual. It is when they take possession of rivers and lakes, and are subjected to sudden changes of drought and frost, that they develop the complicated phenomena of sex. This winter we cannot fail to have been struck with the converse. As we study fungi, from the lowest to the highest forms, we see sex becoming less and less pronounced, as the saprophytic organism becomes more developed. I have spoken much of sex. Why so? Because it forms the basis of all classifications of plants; and a classification to be good should show genetic relationships. Even the artificial classification of Linnæus is founded on the rough and ready way of counting the stamens and pistils and noting their arrangement, and this is sufficient in many cases to indicate great natural orders. Why should this be so? Because the forms in which sex manifests itself record so many different stages in the evolution of plant-life in the long past.

Fungi have an extraordinary power of manufacturing enzymes, the so-called soluble ferments. One of these enzymes dissolves cellulose, and so the fungal mycelium penetrates the tissues of other plants and absorbs their cell contents. What is also worthy of note is, that when fungal filaments come into contact they penetrate into each other. If several spores of mould be grown in the same hanging drop, as they grow they will most likely unite. It is like a forest where the branches of the trees grew together, and so gave an organic unity to the forest.

I might say much more, but must abbreviate this report. Amongst our other cultures, we have tried to grow another class of organisms—those strange little things, half plant and half animal, the Mycetozoa. We have found several in our walks, some in great numbers. In their amœba-like stage they have the curious property of consuming large numbers of bacteria,—thus playing in nature the part which the white blood-corpuscles play in the higher animals.

I began by speaking of energy stored up in the green plant, and of such energy turned into vital action in the fungus. The machine which works for either purpose has the same external form. Let me give a mechanical illustration of a similar kind. A stream drives a water-wheel, the water-wheel drives a dynamo, and the dynamo charges an accumulator. The accumulator may be in a launch or a street car. The accumulator is connected with a motor, and the motor drives the car or the launch. The stream in the living world is the sunlight, the water-wheel is the chlorophyll, the dynamo may be called protoplasm, the energy stored up in the accumulator is starch, or cellulose and the like, the motor is again protoplasm, and the motion is vital action. The same machine may perform opposing kinds of work—the alga is the dynamo, the fungus the motor.

I think one of the aims of the Microscopical Section of this Society should be to produce a few specialists. One man should know mycetozoa well, another diatoms, another lichens, another water-fleas, and so on. We want specialists who know something of the great questions of biology. It was Darwin who said that a man cannot be a good biologist without being familiar with at least one group of living things. He himself, as we all know, wrote a valuable treatise on Cirripedia.

The key-note of our microscopical studies has been the plasticity of protoplasm. You may remember how the old Greek sculptor chiselled the statue of a maiden so beautiful that he fell in love with it, and the goddess at his prayer gave it life. The biologists of the future will be like sculptors—they will not chafe into life the ivory of Pygmalion's statue, they will create new and ideal forms out of living protoplasm.

[The above report was illustrated by a number of microscopic slides.]

EXHIBITS IN NATURAL HISTORY.

The following objects of interest in Natural History were exhibited during the Session at the winter evening meetings of the Society :—

By Mr W. Eagle Clarke.

The Pectoral Sandpiper (*Tringa maculata*)—an American bird got on the Yorkshire coast, September 1897.

By Mr Pittendrigh.

Nest of the Hermit Wasp (?).

By Mr A. B. Steele.

The Armed Bull-head or Pogge (*Agonus cataphractus*), from Newhaven.

By Mr G. M. Brotherston.

A live pair of the Blue Robin (*Sialia sialis*).
A live pair of the Pekin Nightingale (*Liothrix lutea*).

By Mr Pinkerton.

A shell of Cypræa (?), found on the shore at Granton.

A large number of microscopic objects, and of slides prepared and described by members, were also exhibited at the meeting of April 27, 1898.

ANNUAL BUSINESS MEETING.

The Annual Business Meeting of the Society was held at 20 George Street, on the evening of Wednesday, October 26 —Dr Davies, President, in the Chair.

The Secretary reported as follows: "During the past Session there have been 21 meetings — exclusive of the meetings of the Microscopical Section — 6 of which were indoor and 15 were field meetings. The former were, as usual, well attended; while at the latter the aggregate number present was 352, or an average of more than 24 at each meeting—the largest attendance since I took office. Fortnightly meetings for practical work with the microscope were also held during the winter months, and the attendance and work done were satisfactory. Mr James Russell, the new Convener of the Section, has issued a syllabus of the work to be taken up this session. Mr Crawford has again kindly offered the use of his laboratory for the meetings of the Section.

"The working up of the flora of the county has been temporarily stopped, owing to the want of a permanent room in which to store the specimens collected. The Council have appointed a Committee to arrange regarding this matter of accommodation.

"During the year 6 names have been withdrawn from the roll, and 40 new names added, giving at the close of Session 1897-98 a total roll of ordinary members of 202."

The Treasurer tabled his "Statement of Income and Expenditure for year to 18th October 1898," copies of which were already in the hands of members. The balance in favour of the Society was shown to be £38, 3s. 7d.

The Office-bearers for next Session were then appointed, as follows: Mr W. C. Crawford, M.A., F.R.S.E., was elected President in room of Dr Davies, resigned; Mr T. C. Day, F.C.S., was elected Senior Vice-President; Messrs W. Ranken and A. Hewat, F.F.A., were elected Vice-Presidents; Mrs Deuchar, Miss Sprague, and Messrs T. Laidlaw, Chas.

Campbell, James Russell, and W. Williamson, were elected to fill the vacancies in the Council; Mr John Lindsay was re-elected Editor of 'Transactions'; Mr A. B. Steele was re-elected Secretary; Mr George Cleland was re-elected Treasurer; and Messrs R. C. Millar, C.A., and J. T. Mack, were re-elected Auditors.

Dr Davies, in vacating the chair in favour of Mr Crawford, spoke of the prosperity which had attended the Society during the past three years, while he had filled the office of President. He further thanked the members for the uniform kindness and support he had received from them while in office; and expressed the wish that the same prosperity would be continued to the Society in the future as had favoured it in the past. Mr Crawford, on taking the chair, returned thanks for the honour thus paid him, and promised to do what he could to further the interests of the Society in every respect. On the motion of Mr W. Ranken, a hearty vote of thanks was accorded Dr Davies for his services as President; and Mr J. Russell moved a similar vote of thanks to the Secretary and Treasurer.

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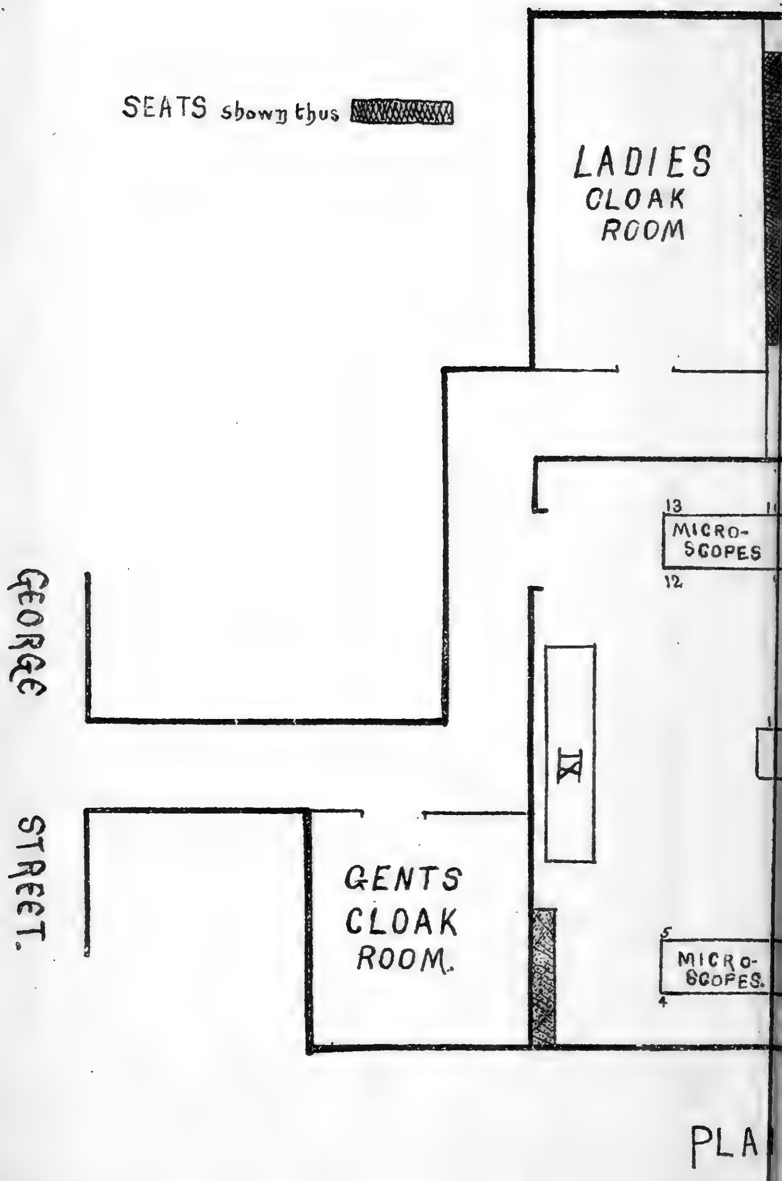
EDINBURGH : FIELD : NATURA



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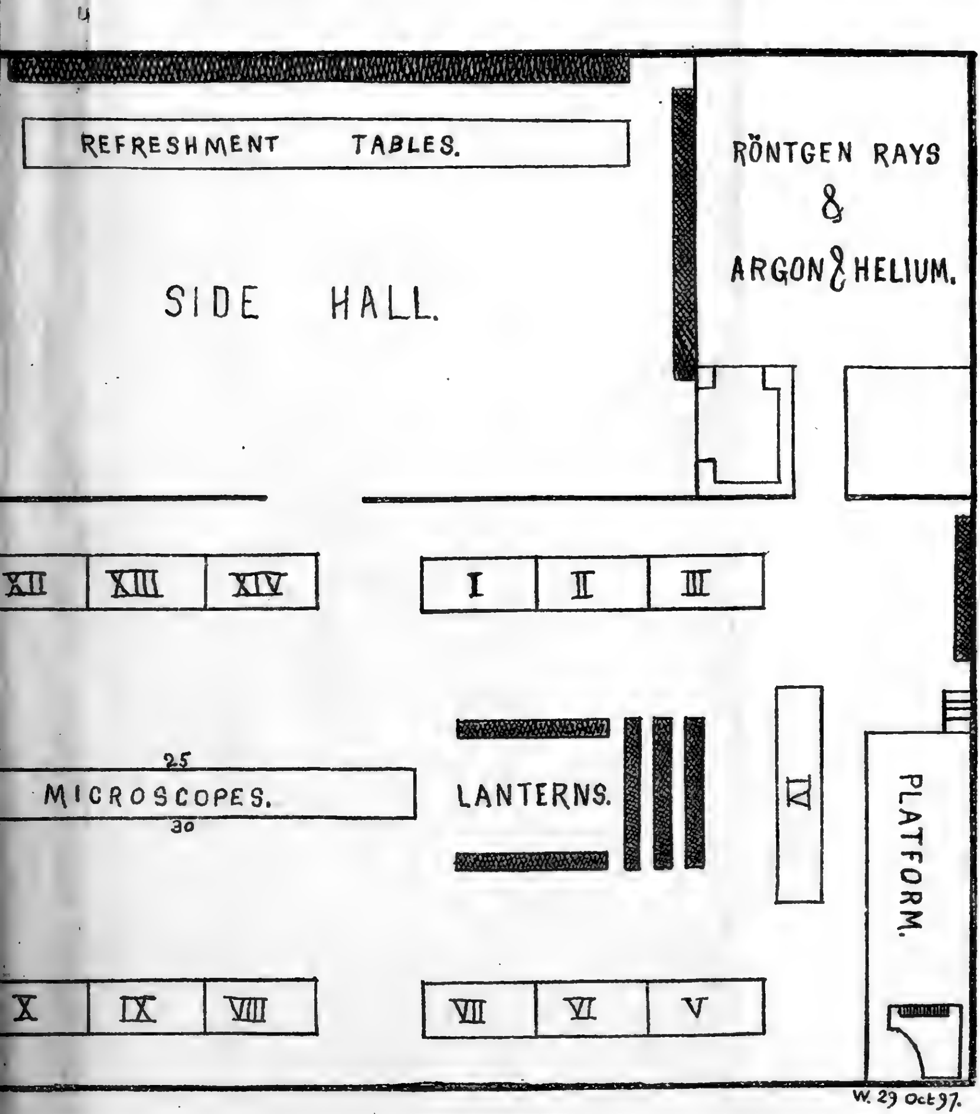

of HALL showing ARRANGEMENT of TABLES.

GEORGE STREET.

LIST OF PAST PRESIDENTS.

Dr Robt. Brown (*deceased*),	1869.	Mr John Walcot,	1879–1882.
Mr R. Scot Skirving,	1869–1874.	Mr A. B. Herbert,	1882–1885.
Mr Wm. Gorrie (*deceased*),	1874–1877.	Mr Symington Grieve,	1885–1888.
Rev. R. F. Colvin (*deceased*),	1877–1879.	Dr William Watson,	1888–1891.
		Dr Sprague,	1891–1895.

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A. E. Davies, Ph.D.

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Editor of 'Transactions.'

John Lindsay.

Secretary.

A. B. Steele.

Treasurer.

George Cleland.

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(As at October 15, 1898.)

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Bryden, Mrs, Linksfield, Aberlady.
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70 Grieve, Mrs Symington, 11 Lauder Road.
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Smith, W. C., 57 Northumberland Street.
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Sprague, Mrs T. B., 29 Buckingham Terrace.
Sprague, Thomas Archibald, 29 Buckingham Terrace.
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Wright, Thomas, 12 Brunton Terrace.
Young, David E., 131 Mayfield Road.

RULES

OF THE

Edinburgh Field Naturalists' and Microscopical Society.

INSTITUTED IN 1869 AS THE

EDINBURGH NATURALISTS' FIELD CLUB.

(REVISED, NOVEMBER 1894.)

I. This Society, instituted for the Practical Study of Natural History in all its Branches, shall be called THE EDINBURGH FIELD NATURALISTS' AND MICROSCOPICAL SOCIETY.

II. The Society shall consist of Honorary, Life, Ordinary, and Corresponding Members.

III. The Office-bearers of the Society shall be a President, three Vice-Presidents, an Honorary Treasurer, an Honorary Secretary, and an Editor of the Transactions. These, with twelve Ordinary Members, shall form the Council, and five shall be a quorum.

IV. The Office-bearers and the four Senior Ordinary Councillors shall retire annually, and the Senior Vice-President and the four Senior Ordinary Councillors shall not be eligible for re-election for a year. The Office-bearers and new Councillors shall be elected by ballot at the Annual Meeting, a majority of votes being sufficient to elect; but the Council shall have power to fill up vacancies during the current year. The Members of Council proposed for election shall be balloted for together; and if not then elected, shall be balloted for separately.

V. Every Candidate for admission shall be proposed and seconded at one Ordinary Meeting, and shall be balloted for at the next Ordinary Meeting—a majority of votes being sufficient to elect.

VI. Ordinary Members shall pay the sum of 5s., on admission, to the Funds of the Society, and contribute thereafter 5s. annually at the October Meeting. Any one wishing to become a Life Member of the Society may do so by paying the sum of £3, 3s. in composition of the yearly Subscriptions. No one shall be considered a Member of the Society until his Subscription has been paid.

VII. No Member shall withdraw from the Society without giving one month's notice in writing to the Secretary of his intention to do so; and his Annual Subscription shall be considered due in default of such notice.

VIII. Any Member may introduce a friend at any Ordinary Meeting of the Society.

IX. A majority of the Members present at any General Meeting, consisting of not less than fifteen Members, shall have the power of expelling any Member whose conduct they may deem objectionable, provided notice of a Motion to that effect has been given at a previous Meeting.

X. Evening Meetings of the Society shall be held, at which papers will be read and discussed—the Council to fix the evenings and hour of Meeting.

XI. It shall be left in the hands of the Council to make arrangements, as they may see fit, for the Field Meetings, in respect to their number and dates. A list of the places suggested shall be submitted to the Members at an Evening Meeting for approval; and the Field Meetings shall be either advertised separately in the local papers on Wednesdays, or an intimation sent to each Member of the Society.

XII. The Annual Meeting shall be held in the fourth week of October, when any alterations in the Laws shall be made; and the Treasurer and the Secretary shall submit statements regarding the position of the Society, and the business transacted in the year. An Abstract of the Treasurer's Accounts, duly audited, shall be circulated with the billet calling the Annual Meeting. Notice must be given in writing to the Secretary before the first day of October of any proposed alteration in the Laws.

XIII. Ordinary business may be transacted at any Meeting of the Society, and Minutes of the proceedings at all Meetings shall be taken by the Secretary. These shall be read at the next *in-door* Meeting of the Society; and, if passed by a vote of the majority present, shall be duly signed by the Chairman, and all such Minutes shall be entered in a book to be kept by the Secretary for the purpose.

XIV. The Secretary may at his discretion call Meetings of Council for the transaction of business; but he shall call a Meeting of Council at the desire of the President, or of two Vice-Presidents, or of any three Members of Council.

XV. Two Auditors shall be appointed annually to audit the Accounts of the Society.

XVI. The Society shall publish annual Transactions, which shall put on record the work done at its Meetings; and these Transactions shall be arranged for publication by the Editor, subject to the approval of the Council.

XVII. The Council shall have power during any Session to enact such Bye-Laws as may be deemed necessary, which Bye-Laws shall have full force until the ensuing Annual Meeting.

XVIII. At all Meetings the Chairman shall have a casting vote.